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Adoption of technological innovations: Towards an integrated approach

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ADOPTION OF TECHNOLOGICAL INNOVATIONS :

TOWARDS AN INTEGRATED APPROACH

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SUMMARY

The purpose of this thesis is to investigate the factors that have influenced the decision of some firms to adopt an innovation by contrasting them to companies which, at the same point in time, have decided to reject the same innovation.

This study has been initiated by the realization that past research has examined the innovation process as two sub-processes (development/introduction and adoption/diffusion). This has obscured the investigation of **a**). issues inextricably linking producers/ suppliers of innovations with potential adoptors, and **b**). the influence of supplier activities upon the decision of firms to adopt or not an innovation.

This study is an attempt to fill this vacuum by analysing the results of an in-depth empirical investigation which was designed to take into account actions of**both** suppliers and adoptors during the innovation process.

By means of a conceptual framework, the adoption or rejection of three technological innovations, by small-sized firms in Greece, was investigated. It was found that, the adoption response of firms was influenced by three main clusters of factors i.e. a) the producers/suppliers' activities (pre-launch activities and commercialising efforts), b) the potential adoptors' perceived tangible and intangible characteristics of innovations, and c) the potential adoptors' conditions which consist of environmental factors and technological and behavioural asymmetries among them.

These factors in turn, formed the basis for theoretical and practical suggestions which are expected to provide a greater understanding of the adoption decision and its conceptual and applied context within the marketing discipline.

To my Grandparents

Nikolao and Bagia Tsiamtsiouri

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CONTENTS

INTRODUCTION

1. TOWARDS AN INTEGRATED APPROACH

The critical role of technological innovation[1] in today's industrial societies has been demonstrated by ample empirical findings. Numerous authors, including Solow (1957), Quinn (1966), Mansfield (1968) and Gold (1980), have postulated that the US economic growth and productivity, until the early 1960s can be credited, to a large extent, to the US economy orientation towards innovations, while its subsequent decline has been blamed by Hays & Abernathy (1980) on the distortion of the above orientation. Others, including Frohman (1982) and Porter (1985), recognise innovation as an essential drive of competition in industry and a powerful competitive weapon of the individual firm.

Although the benefits from technological innovations are well illustrated, Ray (1980), Gold (1981) and Mansfield (1968) argue that they heavily depend upon the extent to which they are utilised. Thus, while the creation of innovations is regarded as a vital condition for the economic well-being of nations, industries and firms, adoption and diffusion of innovations is the ultimate necessary condition for the widespread dissemination of their benefits.

For industrial innovations to achieve widespread acceptance in their markets, producer companies should have a clear understanding in advance, of what factors impinge upon the decision of some firms to make use of an innovation earlier by contrast with other groups of firms. In turn this raises the question of how these factors can be identified and how can the developmental and marketing activities be planned to cope with them. In general terms, these points represent the focus of adoption/diffusion studies within the industrial marketing discipline.

Briefly, marketing researchers, by relying heavily on the empirical findings from other disciplines, have focused their inquiries upon either **a)** the supply-side of innovations (producers/ suppliers); based on the premise that what firms do with respect to their innovations, can provide useful guidelines to other companies or **b)** the side of potential users

[1]See Chapter 1, for an explanation of the working definitions of key terms used in this thesis.

(adopters); recognising that, since they are the recipients of the innovations, an understanding of their conditions is a vital step towards any prescriptive solutions.

However, Foxall (1984) postulated that "the process of innovation links inextricably the behaviour of producers and their customers", and that concentrating only upon either the producers or the customers "can easily obscure the significance of the overall innovative system" (p.24). Recently, Biemans (1992) remarked that product development, adoption and diffusion need to be studied as interrelated processes, and Oakey (1991) noticed that "the marketing literature suffers from the lack of an integrated approach to the full innovation process" (p.346). On the same lines, Rogers (1983) and Robertson & Gatignon (1986,1989) identified this gap in the literature and demonstrated the benefits to be gained by research which will examine the influence, upon adoption/diffusion of innovations, of factors emerging from both the demand (buyers) and supply-side of innovations.

Armed with the above insights, this thesis attempts to bridge this gap by discussing in detail the results of an in-depth empirical investigation which has been purposively designed to take into account both the demand and supply side on the adoption of specific technological innovations.

2. OBJECTIVES OF THE STUDY

The overall objective of the present study is to investigate what factors and in what way, have influenced the decision of some firms to adopt an innovation by contrasting them to a group of companies which, at the same point in time, have decided not to adopt the same innovation.

As it will be seen throughout this thesis, the same objective, although in different terms and from different perspectives, has been pursued by many other studies. Briefly, a review of the literature revealed that the main clusters of variables (factors affecting the adoption response of firms) which have been investigated include: a).*economic factors* (see, inter alia, Mansfield 1968b, Rosner 1968, Romeo 1975, Hastings 1976), b).*organisational and managerial factors* (see, inter alia, Burns and Stalker 1961, Balbridge and Burnham 1975, Kimberly and Evanisko 1981, Carter and Williams 1958, Robertson and Wind 1980) and c).*industry and environment specific factors* (see, inter alia, O'Neal et al. 1973, Globerman 1975, Porter 1985). It is evident that this literature on the adoption/diffusion of innovations lies mostly within the domain of economics, organisational buying behaviour and management science. The marketing literature on organisational adoption is oriented more towards a) *the product/innovation characteristics* associated with the rate of adoption (Hayward and Masterson 1976, Baker and Abu-Ismail 1977, Hayward 1978) or the performance of new products in the market place (Cooper 1979b) b) *the sources of information used during the adoption process* (Ozanne and Churchill 1968, Webster 1969, Czepiel 1974) and c) *the influence of supply-side factors* on the adoption/ diffusion of innovations (Gatignon and Robertson 1989).

On the basis of this literature review, it was realised that the influence upon adoption of supply-side factors has received, comparatively, little attention. Moreover, it was found that the collective impact upon adoption of the many clusters of influential factors, has been examined only by a very small number of studies.

Nevertheless, Gatignon and Robertson (1989) postulated that more attention on the supply-side factors would "enhance our understanding of the adoption of technological innovations by firms" p.47. In addition, Kimberly and Evanisko (1981) suggested that more research is needed on the combined influence upon adoption of the many sets of factors which have been examined in the literature.

Armed with the above insights, this thesis has three more specific objectives, which are as follows.

1. ***To advance the current understanding of the supply-side factors and their influence upon the adoption response of firms towards an innovation.***

2. ***To assess the collective influence upon adoption response, of the factors which in the present study are hypothesised to impinge upon the decision of firms to adopt or reject an innovation.***

3. ***To bring forward and use a methodology which will enable researchers to explore the entire innovation process in its continuous reality i.e. from idea generation to the actual adoption or rejection of the innovation in the market place.***

3. *AN OVERVIEW OF THE STUDY*

When a particular subject or academic topic has matured, it is often possible to gain a clear understanding of it by studying a representative cross section of the current literature. However, the body of knowledge pertaining to industrial adoption of technological innovations is by no means near the saturation point. A review of the current literature reveals, that while some aspects of innovation adoption have been investigated to a great extent, some others are still surrounded with contradictions and controversies and others, are virtually in darkness. Almost every scholar in the field is urging for more research in the adoption of innovations (e.g. Gatignon & Robertson 1989, Biemans 1992).

In the course of the present inquiry, three major clusters of factors, affecting the adoption response of firms, were identified and examined through this study. In general terms, they include **a)** factors related to suppliers of the innovations, **b)** factors related to buyers of the innovations, and **c)** factors related to the tangible and intangible characteristics of the innovations.

To examine these points, a conceptual framework was developed to encompass the clusters of factors which were hypothesised to have influenced the adoption response of firms in the present study. This in turn, was used as an analytical tool to guide the selection of key variables within each cluster of factors. Although this framework will be explained later in chapter 6, a brief explanation of its dimensions (clusters of factors) here, may shed more light on the objectives of this thesis.

3.1. *Supply-side factors* include factors related to a) the industry of the supplier(s), and b) the supplier's activities during the pre-launch and the commercialisation period of its innovation. This dimension of the framework suggests that, the development and commercialisation (marketing) efforts of the supplier have a direct impact upon the decision of firms to adopt an innovation.

3.2. *Buyers' side factors* include factors related to a) the industry and environment of the buyers, and b) key characteristics of their organisations. The framework employed here suggests that, with regard to technological innovations, the key characteristics of the firm, that influence its adoption response, are those manifesting the technological and behavioural dimensions[2] of its innovativeness. The conceptual framework postulates that technological and behavioural asymmetries among firms constitute another cluster of factors which impinge upon their decision to adopt an innovation.

3.3. *Innovations' related factors* include the perceptions of the potential adopters with regard to the characteristics (tangible and intangible) of the innovations. In the conceptual framework, these perceptions represent the degree of 'fit' of an innovation with the objectives, needs and capabilities of a prospective adopter. As such, they have a direct impact upon the decisions of firms to adopt an innovation.

The conceptual framework advanced here, suggests that an industrial marketing researcher or marketer wishing to have a clear understanding in advance, of what factors impinge upon the decision of firms to adopt an innovation, should consider factors from all the categories above, as well as their collective influence. To do so, suppliers should realise that the innovation process is a continuous process and that their activities, throughout this process, have a direct impact upon the decision of firms to adopt their innovations.

The new conceptualisation, of the factors impinging upon the decision of firms to adopt an innovation, unravels a whole new array of activities that suppliers can employ in their efforts to achieve a widespread acceptance of their innovations in the market place. Currently, these activities derive from an extreme focus of research to the demand or buyers' side, (i.e. marketers should manipulate their firms' marketing mix variables in order to adjust their innovations (offers) according to the conditions and needs of the buyers). However, the present conceptualisation of the factors influencing the adoption response of firms suggests that, suppliers can (in addition or in combination):

a) *adjust their innovation (offer) continuously* i.e. R&D and marketing activities can be used throughout the innovation process, and not only at the development or commercialisation (adoption) phase respectively.

[2]See Chapter 1 & 6, for an explanation of these terms

b) *assist or educate the buyers* thus, adjusting the buyers' conditions to enable a positive adoption response and a profitable use of the innovation.

c) *improve their own role in the industrial adoption of innovations* by realising that supplier related intangible characteristics of the innovations should be understood too and modified accordingly. The latter is a direct result from the conceptualisation of the innovation process as an interactive one and as such, inherent to it is the opportunity of the supplier to understand the buyer.

The lack of concrete empirical evidence behind many of the above issues dictated the use of a research design that would allow for their in-depth investigation. To this end, a limited cross-sectional research design was employed and a combination of research instruments and methods were used to warrant sufficient exploration and description of the issues involved.

The researcher approached two organisations, namely EOMMEX and OPE,[3] and the Greek Ministry of Industry Research and Technology in order to identify technologically innovative products in Greece. From a list of innovations, three were selected which have been recently developed and adopted by small-sized firms in Greece, namely a CNC wire bending machine, a NC packaging machine and a Switching power supply system. Their producers were contacted and, by means of personal in-depth interviews, the development and marketing activities of their innovations were investigated. Successively, their sales files were used to identify the firms that adopted each innovation, as well as those which had been contacted by the producers, but they rejected adoption after evaluation. At the point in time of the study's undertaking, adopters of the innovations were characterised as early adopters, owing to the fact that the innovations have been introduced on to their markets recently.

Following this, each customer firm was taken as a unit of adoption and the factors expected to have influenced their adoption response were investigated by means of two questionnaires, a semi-structured and a structured one, which were addressed to the managing director of each firm during personal interviews. The study continued by juxtaposing the

[3] EOMMEX: Greek Organisation for Medium and Small size Manufacturing firms and Handicraft, OPE: Organisation for Exports Promotion

insights gained from the suppliers of innovations with those gained from the adopters and non-adopters of the same innovations. Furthermore, a comparison was made among adopters and non-adopters with the aim a) to understand how different factors have influenced their adoption response, and b) to assess the collective impact of these factors upon their adoption response. The latter produced a profile of adopters of the innovations under consideration, by contrast with a group of firms which, at the same point in time, had actively rejected adoption of the same innovations.

On the basis of this inquiry, it is believed that this study has managed to introduce and highlight a number of issues which are appealing to many parties interested in technological innovations. It is hoped that, this new source of empirical data on issues yet in need of more research will assist scholars in their efforts towards a greater understanding of the adoption of innovations within the marketing discipline.

Producers/suppliers of innovations may find the present study and its suggestions particularly relevant to their development and marketing activities. By the same token, the identification of factors that influence the capabilities and behaviour of firms towards adopting an innovation, may assist prospective adopters to protect, or even strengthen their competitive position by eliminating the negative factors, and by enhancing the positive or favourable ones. Finally, government policy makers may find this study assisting their attempts for appropriately focusing their development and investment programmes.

4. *ORGANIZATION OF THE STUDY*

The first chapter of this thesis unfolds the working definitions of key terms used in the present study. Following this, the next four chapters provide a literature review of the field and of the factors which have been found influencing the adoption response of firms. Owing to the large number of factors that have been investigated in the past, the author classified them in different blocks namely: supply-side factors, innovations' characteristics, economic factors, organisational and managerial factors and factors relevant to the external environment of firms. That was expected to assist their meaningful review.

The remaining three chapters present a) the conceptual framework developed in this thesis and the methodology employed to explore a number of issues and hypotheses, b) the analysis of the data collected in the field research, and c) its theoretical and practical implications.

More specifically:

Chapter 1 explains the working definitions of key terms used in the present study, and attempts to delineate its disciplinary perspective by positioning the present study within the spectrum of other disciplines and similar studies. Its purpose is to assist the reader to ground the ensuing discussion.

Chapter 2 reviews empirical findings from studies focusing upon innovations' successes and failures, and develops a theoretical framework on how supply-side factors affect the adoption response of firms towards an innovation. As such, it suggests that the activities undertaken by the suppliers during the pre-launch period of the innovations, as well as during the adoption and diffusion period should be considered explicitly.

Chapter 3 reviews literature pertaining to innovations' characteristics and the perceived risk of the adoption decision. Emphasis is given here on empirical findings concerning intangible characteristics of innovations.

Chapter 4 demonstrates a) the influence upon adoption of economic factors; it illustrates the confusing interpretations of their influence upon adoption and attributes it to the inability of economic indicators to reveal, as such, their underlying causes, b) a selective review of studies which have encountered the influence upon adoption of organisational and managerial factors.

Chapter 5 examines the influence upon adoption of factors exogenous to the adopting firm; to this end, various components of the firms' external environment are investigated and suggestions are offered of how the yet limited understanding of their influence can be improved.

Chapter 6 gives an overview of the present study and develops a conceptual framework to guide the selection of issues and variables under investigation. Moreover, on the basis of the study's objectives and its literature review, it develops specific research hypotheses to be tested by means of the field study and the statistical procedures, which are explained in the second part of this chapter.

Chapter 7 is divided into seven sections which examine the data collected from the field. Data are analysed by means of appropriate statistical methods showing which hypotheses were confirmed and which were not.

Chapter 8 highlights the key findings and conclusions drawn from this study and puts forward its theoretical and practical implications. Moreover, the study's limitations are appreciated and directions for further research are recommended.

Finally, this thesis is accompanied by its appendices which include a) a transcription of the case studies undertaken within the producers of the innovations under consideration, b) the brochures of the innovations, c) the questionnaires which have been used for the selection of the empirical data, d) a number of issues which also have been examined in this study and e) an introduction to the use and validation of discriminant analysis; a statistical technique which has been used for the analysis of the data in this thesis.

Having explained the objectives and the organisation of this thesis, the next chapter will attempt to put forward the working definitions of some key terms used in this study, and to delineate its disciplinary perspective.

CHAPTER ONE

WORKING DEFINITIONS & POSITIONING OF THE PRESENT STUDY

1.1. INTRODUCTION

Owing to their importance, innovations have been subject to a considerable amount of research in a variety of disciplines such as sociology, communication, anthropology, economics, engineering disciplines, public health, medical sociology, psychology, marketing, consumer and industrial buying behaviour (Rogers 1983, Gronhaug and Kaufmann 1988). As such, while everyone 'knows' the meaning of words like 'innovation' and 'adoption', every researcher has his own working definitions (e.g. Rogers 1983, Downs and Mohr 1976, Foxall 1984a). This in turn, restricts comparability of studies and makes any attempt to construct a common theory of innovations very difficult if not impossible (Downs and Mohr, 1976).

Although the latter problem is hardly unique to innovation research, it is felt most acutely in research areas which are not discipline-specific (Warner 1974). Consequently, the author holds the view that in the present study, as well as in any other study where similar problems are encountered, introductory definitions are required of the main concepts involved, in order to ground the ensuing discussion.

Therefore, one objective of this chapter is, to explain how the terms of technological innovation, adoption/non-adoption and innovativeness of adopting firms are defined in this study. However, it must be stated here that this chapter is not intended to offer any clear-cut solutions to the problems raised by the diversity of working definitions. Rather, it represents an attempt to delineate the perspective employed throughout the conduct of this study, and a sharing of the concerns and issues, rarely voiced in the literature, which the author has encountered in the present study.

Another objective of this chapter is, to position the present study and to establish its originality within the spectrum of other disciplines and similar studies. The latter is of great importance since, although the present study acknowledges and considers the findings from other disciplines, it has its own disciplinary perspective i.e. that of the adoption of innovations within the realms of industrial marketing.

1.2. DEFINING INNOVATION

The most widely used definition of innovation is the sociological definition by Rogers (1983), which states that "an innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption" p.11. Rogers remarked that it matters little, so far as human behavior is concerned, whether or not an idea is "objectively" new as measured by the lapse of time since its first use or discovery.

Without any qualifications, the above definition has been employed by researchers in the field of innovation research. As such, Zaltman, Duncan and Holbek (1973) defined innovation as an idea, practice or material artefact perceived to be new by the relevant unit of adoption. However, Dewar and Dutton (1986) postulated that this definition does not take into account the fact that innovations vary in the degree of newness to an adopting unit. To this end they suggested the terms 'radical' and 'incremental'. Radical innovations are fundamental changes that represent revolutionary changes in technology, whilst incremental are minor improvements or simple adjustments in current technology. They suggested that, there is a continuum of innovations that range from radical to incremental depending upon the degree of new knowledge embedded in the innovation. Dewar and Dutton subscribed to the idea that an innovation entails risk for the adopting unit, whilst Downs and Mohr (1979) postulated that "innovation then becomes defined as the use of a new idea, technique, and so on, when there is uncertainty attached to the enterprise" p.28.

In contrast with the above definitions, Foxall (1984a) suggested that "the interest of marketing researchers and managers in customer innovation... focuses upon the fact that the products involved are new in the sense that of having been recently launched on to the market" p.92. The latter coincides as to the definition of innovation in the New Collins English Dictionary i.e. something newly introduced.

All the above definitions include the notion of newness of the product involved. However, in the former definitions newness is conceptualized in terms of new knowledge, whilst in the latter it means that the product has been recently introduced on to the market.

The author's conjecture is that these two conditions should be both present for a product to be characterized as an innovation and as such, to be of interest to researchers in the field of adoption of innovations. This can be justified by the fact that a product incorporating new knowledge which, however, has not been recently introduced, is not an innovation because, the adopting unit can reduce its risk and uncertainty by capitalizing upon the experience of already adopters. By the same token, a product, which has been recently introduced but does not incorporate new knowledge, is not an innovation owing to the fact that the adopting unit again can reduce its risk and uncertainty by referring to the experience of firms using quite similar products.

Armed with the above insights, technological innovations are defined in the present study as products, processes or other material artefacts that utilize new technology (thus they incorporate new knowledge) and have been recently introduced on to their markets. Inherent to this definition is the uncertainty and risk faced by the adopting unit owing to the new knowledge involved and the lack of experience since, by definition, few if any other customers have as yet tried the innovation.

It is obvious that, the definition adopted here is not free from the word 'new'. As in many other studies of innovations, this creates a methodological problem to the researchers i.e. who is to judge the 'newness' of the innovations to be employed in their studies. To overcome this problem researchers have used the opinions of experts in the field and/or have consulted lists of innovations which, again, have been compiled by experts (e.g. Dewar and Dutton, 1986). As it was shown previously, the present study employed a similar approach.

1.3. DEFINING ADOPTION & REJECTION

When defining adoption or rejection it is important to recognize that we are speaking of elements in a decision-making context or choice situation (Downs and Mohr, 1979). This context includes the innovation-decision process which is "the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision" (Rogers 1983, p.163).

According to Rogers (1983) adoption is a decision to make full use of an innovation as the best course of action available and, rejection is a decision not to adopt an innovation.

However, Rogers conceptualized adoption as a mental exercise and suggested that it becomes overt behaviour only at the implementation stage of the innovation-decision process, i.e. when the innovation is actually put into practice.

Bearing in mind the above definition, research on the industrial adoption of innovations has followed two directions, in an attempt to answer the following questions:

a) How do firms move along the innovation-decision process? This direction has been characterized as process research, and it is of a dynamic nature (See for example, Avlonitis and Parkinson 1986).

b) Why some firms are early in the adoption of an innovation? Here, the characteristics of early adopters of innovations are compared with those of firms that have adopted the innovation later, or of firms which have rejected the idea to adopt the innovation in question at the point in time of the study's conduct. In this direction, adoption represents an overt economic behaviour of the firm i.e. by means of an economic transaction the firm has bought the innovation.

Clearly the latter direction does not take into account the fact that a firm which has rejected the adoption of an innovation at present, may adopt it later in the future. However, Gatignon and Robertson (1989) found that rejection "is not the mirror image of adoption, but a different form of behavior" (p.47), and they suggested that more research is needed to investigate its determinants. On the same lines, Rogers (1983) attributed the lack of attention to the rejection behaviour of firms to the pro-innovation bias of researchers. Moreover, Eveland (1979) made the distinction between active rejection, which consists of considering adoption of the innovation but then deciding not to adopt it, and passive rejection, which reflects the situation where the firm has never considered the use of the innovation.

Armed with the above insights, the present study employs a snapshot view of the markets involved because, it examines the adoption response of firms at a fixed point in time. Within this context, adopters are the firms which have bought the innovations involved, whilst non-adopters are firms which evaluated the innovations but decided not to buy them. As such, non-adopters are active rejecters of the innovations and therefore, the two terms (i.e. non-adopters, rejecters) are used interchangeably throughout this thesis.

Owing to the view employed here, the author appreciates the fact that the latter group of firms may adopt the same innovations or may settle for other competitive products later on. However, at the point in time of the study's conduct, the only overt behaviour of this group was that of active rejecters of the innovations under consideration. Having said that, their inclusion in the present context is justified by the fact that, as it was previously shown, very little is known about their behaviour. Clearly, a context which will include active rejecters alongside other groups of firms (e.g. later adoptors, laggards or adoptors of competitive innovations) may shed additional light to the current issue and may assist to the generalizibility of the present study's results.

Moreover, the present thesis approaches adoption and rejection within the entire innovation process. It regards the innovation process as a continuous process which covers all that goes on from the generation of an idea to the research and development of a product, through to the marketing of it and its use in the market place. The process is continuous in two additional aspects: a) the R&D and Marketing activities of innovations' suppliers take place throughout the innovation process (i.e. both at the developmental phase and after the introduction of the innovation in the market place) and b) the entire innovation process is characterized by a continuous interaction among suppliers and buyers. The latter interaction is of prime importance for the development and any later modifications of the innovation as well as, for its acceptance and diffusion in the market place. As such the innovation process in the present study is conceptualized as incorporating a 'heuristic' element i.e. supplier and buyers interact and learn from each other.

1.4. DEFINING INNOVATIVENESS

Almost every study in the adoption of innovations has faced, sooner or later, the issue of the innovativeness of the potential adopting units. This can be attributed to the fact that, researchers have devoted substantial efforts attempting to determine the factors underlying the innovativeness of organizations. As such, a considerable amount of insights in the field of adoption of innovations has been drawn from this research direction.

Nevertheless, Foxall (1984a) remarked that "the quest for innovativeness is marked not only by theoretical dispute but by differences over methodological design and the interpretation of results" p.131. The following discussion therefore, attempts to clarify how innovativeness of organizations is taken into account in the present study.

1.4.1. THE EXTANT CONCEPT OF INNOVATIVENESS

According to Rogers (1983) innovativeness is "the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than any other member of the system" and as such, "innovativeness indicates behavioural change..." p.242. On the basis of the above definition of innovativeness, a variety of measures have been used for its assessment in the relevant literature. These are as follows:

a). The elapsed time of adoption. The use of this measure has resulted to a categorization of the potential adopters of an innovation, which according to their time of adoption are distinguished as Innovators, Early adopters, Early majority, Late majority and Laggards (Rogers, 1983).

b). Subjective measures, as they have been assessed by asking experienced investigators to rate the technical state of each firm within the study (Carter and Williams, 1959).

c). A dichotomous variable (0/1), where 1 represents the adoption of an innovation and 0 indicates the non-adoption of it (Moch and Morse 1977, Gatignon and Robertson 1989).

d). The number of innovations adopted by a firm out of a list of innovations (Cohn 1980).

These measures of innovativeness indicate that only the 'elapsed time of adoption' is consistent with Rogers' definition of it. Nevertheless, the time horizon of adoption and the relative categorization of the firms which has served the scientific needs of researchers for more than 20 years and has produced valuable insights into the process of adoption and diffusion, has been criticised to a great extent. This criticism relates mainly to the fact that firms which were early adopters for a specific innovation might be late adopters or even laggards for another innovation which applies to a different part of that firm (Mansfield 1968b, Midgley and Dowling 1978). This of course, by no means assure the proper placement of a firm into a category of adopters; which in turn obfuscates any attempts to formulate and focus marketing policies on the basis of the above categorization.

Johne's (1984) remarks illustrate the confusion of the researchers, resulted from the operationalization of the extant concept of innovativeness of organizations: "Of course, measuring the time taken to adopt two product classes is not strong evidence with which to support the contention that innovator firms will buy new advanced components ahead of positional firms. The evidence is, however, sufficiently interesting and also sufficiently suggestive to make us suspect that innovator firms will normally tend to lead in the adoption of new advance components when these are relevant to their marketing needs" p.60.

Johne became a strong supporter of the view that leadership in technological innovations is primarily a consequence of strategic decisions and actions. Authors that have subscribed to this view have used the terms 'offensive' or 'defensive' (Freeman, 1974), 'proactive' or 'reactive' (Urban and Hauser, 1980), 'entrepreneurial' or 'positional' (Ansoff, 1979), 'leaders' or 'followers' (Johne, 1982), as synonymous to the innovativeness of organizations, with regard to their behaviour towards innovations (see Miles and Snow 1978)

However, Midgley and Dowling (1978) postulated that "innovativeness and relative time of adoption are not synonymous concepts. The former is a hypothetical construct, while the latter is a low-level operational variable, and between the two lies a system of intervening variables" p.237.

In addition, the author deems that the following arguments can be directed against the extant concept of innovativeness:

a) The actual time of the adoption of an innovation might be determined by its supplier rather than by the adopting firm. To this end, Simon and Sebastian (1987) found that unavailability of a product due to limitations or difficulties in production might create a waiting line of potential adopters which will slow down the diffusion of the innovation. Similarly, Mahajan et al. (1990) maintain that diffusion patterns of certain products such as prescription drugs can be influenced by controlling their supply and distribution.

By the same token, suppliers and potential adoptors may use/prefer different methods for the exploitation-acquisition of technological innovations, such as licensing, franchising, mergers, joint ventures, educational acquisitions (Ford and Ryan 1981, Ford 1988, Clarke et al. 1988). However, owing to their complexity, some methods take more time to realise thus, resulting to different time horizons of adoption and therefore, to early and later adopters in time.

These issues suggest that researchers will be able to identify firms that adopted an innovation(s) earlier or later than other firms however, not because of their 'better' or 'worse' innovativeness (behaviour) but instead due to other factors which, sometimes, lie outside their own control.

b) Changes in the rates of innovation adoption might be a result of significant improvements in the innovation(s) being studied, which increase the net attractiveness of the innovation(s), rather than a result of changes in the receptivity (innovativeness) of prospective adoptors (Gold, 1981).

c) From an epistemological point of reference, the 'elapsed time of adoption' and the categorization of potential adopters gives the impression that, during the diffusion of an innovation, always will exist firms which owing to their different levels of innovativeness will adopt earlier or later than others. Therefore, the role of the marketer might be perceived as of simply identifying those firms. However, Robertson (1984) postulated that "...marketing actions by their very nature are designed to change the diffusion process to the firm's advantage". Clearly, the latter indicates that marketing actions by themselves distort any categorization scheme of firms on the basis of their innovativeness.

d) Finally, from a marketing point of view, an early adoption of an innovation may well result to further low rates of adoption or even to the abandonment of it in the market place if, a) the adopting unit is not yet able to fully utilize this innovation or, b) when the use of the innovation demands the former changes of its inputs (i.e. raw materials), and/or the creation of a favourable attitude to the final users of the end product of that innovation. This highlights the fact that without the latter qualification, marketing's attention to the very early adopters might be proved detrimental to the innovation's performance in the market place.

With regard to strategy,[4] Saren (1987) argued against its primacy in determining the pace and type of technological innovation. He concluded that "the interconnectedness between all of these determining elements (i.e. elements other than strategy associated with technological innovation)[5] and the inherent uncertainty of the innovation process itself do provide strong grounds for reservations as to the primacy of strategy in determining the nature and direction of technological innovation". p.165

Similarly, Foxall (1984a) postulated that "the description of buyer behaviour as strategic in the senses of orderly, systematic and purposeful interaction with the environment requires qualification: it may be possible to build *ex post* a pattern of apparent ends-means relationships from data which describe consumers' decision and behavioural processes; it is quite another task to attempt to predict from decisional statements of intention what strategies will be employed and it is often difficult to predict from such decisions what ends will actually be pursued" p.105.

On the same lines, Freeman (1982) maintained with regard to types of strategy that "in practice there is an infinite gradation between types, and many individuals posses characteristics of both types. Moreover, individuals (and firms) do not always behave 'true to type'. Finally, people and firm strategies are always changing, so that generalizations which were true of a previous decade will not necessarily be true in the next" p.169.

These arguments indicate that, the same confusion underlying the concept of 'innovativeness' also surrounds the concept of 'strategy' with regard to innovations.

1.4.2. A NEW CONCEPT OF INNOVATIVENESS

Recently, Dosi (1988) suggested that innovations "entail ceteris paribus an *asymmetry-creating effect*, which allows some firm(s) to enjoy some improvement in its competitive position" (p.1159). These asymmetries have a technological and a behavioural component

[4]Strategy is perceived, here, as connoting a set of broad commitments made by a firm that define and rationalize its objectives and how it intends to pursue them (see Nelson, 1991, p.67).

[5]Explanation added.

and, as such, they are the result of different degrees and histories of technological accumulation, and different managerial strategies respectively.

Capitalizing upon Dosi's assertions, the author believes that it is misleading to relate innovativeness of organizations with only one single action in the past i.e. the adoption of one or a small number of technological innovations. Rather, innovativeness denotes an array of activities in the technological and behavioural sphere of firms. ***As such, innovativeness of organizations represents a latent capability of firms, which is composed of two critical dimensions, a technological and a behavioural one.***

In this way, innovativeness of organizations is being treated as a two-dimensional concept which denote the capacity (technological dimension) and the commitment (behavioural dimension) of the firm to innovate. On the same lines, Foxall (1984a) postulated that "innovativeness is the capacity and tendency to purchase new products and services" (p.128).

Moreover, the new concept of innovativeness of organizations is a cumulative one, in the sense that it can be build and triggered thus producing a favourable inclination of the firm towards any technological innovation.

Given this new concept of innovativeness, two points need to be clarified. Firstly, cumulativeness in this concept must not be related solely to 'evolutionary' assumptions similar to the ones expressed by Burgelman and Rosenbloom (1989) regarding firms' technology. In contrast, the author acknowledges that innovativeness can be achieved 'synchronically' with the adoption of technological innovations. The latter does not undermine the new concept of innovativeness. Instead, it highlights the need of possible side investments associated with an innovation (Mansfield 1968b) which however, impede its adoption in the short-run by increasing the overall cost of the innovation. Secondly, the new concept of innovativeness is not associated with the adoption of specific innovations and therefore, innovativeness alone cannot explain the adoption or rejection of specific innovations. Rather innovativeness of organizations mediates adoption of a technological innovation. In other words, the adoption of an innovation by a firm documents partly an expression of its innovativeness.

Similarly, from a consumer marketing point of view, Midgley and Dowling (1978) have put forward the view that innovativeness should be conceptualized as a mediating factor.

1.5. POSITIONING OF THE STUDY

The present study employs an industrial marketing research perspective since it examines the adoption of technological innovations within industrial markets. This is in line with the need expressed by many scholars for more research in industrial markets (Bamossy and Van Eenennaam 1989, Biemans 1992, Foxall 1984a).

Nevertheless, as it was mentioned above it is important to recognize that we are speaking in relation to a decision-making context or choice situation with regard to a product. This context also has been investigated in the areas of organizational buying behaviour and brand choice. However, there exist clear differences between the focus employed by researchers in the area of innovations' adoption (and thus of the present study) and that followed in the areas of organizational buying behaviour and brand choice. These are as follows.

A. Research in organizational buying, has examined the buying behaviour of firms in general buying situations. In other words, neither the products examined were qualified as innovations, nor the researched units (firms) were early adopters of the products involved.

In contrast, researchers in the adoption of innovations concentrated their attention upon the earliest adoptors of innovations since, it is their behaviour upon which "the inauguration of the diffusion process relies and who require and justify differentiated marketing appeals" (Foxall, 1984a, p.93). Clearly, one might argue that, firms facing "new task buying situations" (Robinson et al., 1967) might be buying products which are innovations (in the definition adopted above) and might be early adoptors of these products. However, not every new task situation involves 'innovations' and 'early adoptors'. Therefore, the strategic interest of marketing researchers and managers in innovations and early adoptors confines their frame of reference to just a proportion of the firms facing new task buying situations (Foxall, 1984a).

B. By the same token, a new brand (i.e. a product specified by its supplier's name) might be an innovation. In the consumer marketing research the brand name of a product has been operationalised as a surrogate indicator of the products' 'quality' (Engel et al., 1978). Its most outstanding finding has been the fact that under conditions of extended problem solving, repurchase and high involvement, the individual's choice of a brand/product is highly influenced by his/her brand loyalty (Engel et al., 1991). The importance of brand loyalty has been recognized in the organizational buying behaviour research, and has been conceptualised as a mechanism, among other things, capable of reducing the perceived risk of the buyer (e.g. Bettman 1973, Puto et al. 1985, Mitchell 1990).

Nevertheless, research on the adoption of innovations systematically has avoided dealing with the adoption of branded innovations. Instead, it has concentrated upon the adoption behaviour of firms with regard to 'product classes'. Clearly, this attention can be attributed to the need of every researcher to claim that his/her study's results are generalizable to every other product in the same product class. But, such a methodological design does not take into account differences among the products in the same product class. Indeed, products in the same product class might have a certain functional coherence (Kotler, 1988), but it is well established that the functional (technical) characteristics of a product are not the sole determinants upon which is based the adoption decision of industrial buyers (e.g. Shaw et al. 1989, Kassicieh and Rogers 1986). It seems that researchers in the adoption of innovations have depreciated the fact that products are not simply functional units, but supplier' specific (Hill and Hillier, 1977), augmented and potential products (Kotler, 1988). This then, can be held, partly, responsible for the limited attention of innovation researchers to the influence upon the firms' adoption decision of the source of the supply (i.e. supply side factors) and the intangible characteristics of the product. Only recently, researchers have acknowledged the importance of the latter (Gatignon and Robertson, 1989).

The preoccupation of innovation researchers with product classes, is so deeply rooted in their methodologies, that even when they were examining the adoption behaviour of firms towards a branded innovation, they were claiming that the innovation is representative of a class of innovations. To cite just one of the many examples, Baker (1975a) investigated the characteristics of adoptors of two innovations. The first one, was the Box Toe Applying machine (BTA), manufactured and introduced as a unique innovation (i.e. no competing alternatives) by the USM's Chemical Division, Boston. The second one, was a numerically controlled turred drill machine, manufactured and introduced by the Cintimatic Division of the Cincinnati Milacron company. This innovation was not a unique one. However, Baker stated that "it is felt to be representative of a class of innovations 'numerically controlled machine tools'...thus whereas potential users of NC turred drills were faced with a choice from competing alternatives it is assumed...that the characteristics of purchasers of Cintimatics are similar to those of purchasers of competitive alternatives at similar stages of the diffusion process" p.117.[6]

In the present study, a context of three branded innovations is employed of which, one is 'unique' (sic)[7] and the remaining two, although they incorporate new technological aspects, they are competing with other branded products that perform the same function. Following Baker's assumption, the present study may, as well, assume that the latter two products, are representative of their product classes i.e. numerically controlled packaging machine tools and power supply electronic components. In spite of that, the author deems inappropriate to make the same assumption. Rather, the author acknowledges that the context followed here, as well as in any other study that investigates a limited number of products or situations, imposes limitations on the generalizibility of the study's results.

Nevertheless, the context followed here, was deemed to be appropriate for exploring issues with regard to the suppliers of the innovations and for following the innovation process in its continuous reality. As such, the present study does not investigate the factors that led firms to choose one brand over another. Instead, it explores how, inter alia, supply side activities (i.e. not only the brand name) have influenced the decision of firms to adopt or reject at a point in time the innovations under consideration.

Moreover, the tenor of the present study is an integrative one since: a) by reviewing the empirical findings from many salient fields of inquiry, it brings together the extant adoption paradigm with the emerging supply side one, and b) it considers variables which emphasize

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[6] See Chapter 8, for more examples.

[7] Using Baker's terminology.

different aspects of innovations and examines their combined effect upon the adoption behaviour of industrial firms.

As such, the comparative value of this study with other particularly relevant studies in the field can be assessed as follows. Compared with the studies of Gatignon & Robertson (1989) and Bamossy & Eenennaam (1989), this study extends the supply side paradigm to include the suppliers' pre-launch activities of their innovations, alongside their marketing activities during the period of adoption and diffusion, and assesses explicitly their influence upon the adoption decision of potential adopters. To this end, the processes of innovation development-adoption & diffusion are conceptualized in this study as a continuous one, rather than simply single-directional interrelated (See Biemans 1992, p.62), and the actions of suppliers are viewed as a continuum. Moreover, in comparison with Biemans (1992) study which concentrated upon the development of innovations, the present study is based upon the adoption and therefore, allows adoptors and non-adoptors to express in their own words which properties of the suppliers have influenced, among other factors, their decision to adopt or reject the innovations in question.

Furthermore, as compared to many other studies on the adoption of industrial innovations, the present research is different for the following reasons: a) it examines the influence upon adoption of a number of industry specific factors and the competitive environment; these issues have received little attention in past research (Gatignon & Robertson 1989), b) it makes use of the intrasectoral adoption paradigm, currently emerging in economics (Dosi, 1988), which attributes the innovative capabilities of firms, partly, upon their history of technology accumulation; this in turn, accords with the currently rising interest in many fields in the technology dimension of business (Nelson 1987, Burgelman and Rosenbloom 1989, Kantrow 1980, Capon and Glazer 1987, Ford 1988); c) it considers the adoption of technological innovations by small-sized firms; to this end, although the understanding of the role of small-sized firms in the development of innovations is reasonably adequate, little is known about their behaviour when it comes to the adoption of innovations (Lefebvre et al. 1991), d) finally, this study allows for a comparative exploratory investigation of the reasons for adoption and rejection; this is in harmony with Gatignon and Robertson's (1989) remarks that "this is an area yet untapped by diffusion researchers" p.47.

Having explained the working definitions employed by the present study and positioning it within the spectrum of other disciplines and similar studies, the next chapter develops a theoretical framework of how supply side factors affect the adoption response of firms towards innovations. In this attempt, the author was assisted by literature pertaining to success and failure of innovations. As such, a selective review of this literature is presented also, and its relevance to the objectives of this study is established.

CHAPTER TWO

THE INFLUENCE OF SUPPLY SIDE FACTORS

INTRODUCTION

One of the main objectives of innovation research, especially in the marketing domain, is to assist firms in their attempts to initiate, develop and market their innovations to their potential customers. In a normative way, innovation research suggests that firms capitalising on past empirical evidence will be able to initiate and develop 'better' innovations, and to market them 'better' to their customers. In essence, this means that suppliers can influence, through their activities, the performance of their innovations in the market place and successively their adoption and diffusion rates.

However, these very activities of the producers and suppliers of innovations have not been taken into account in the adoption and diffusion research. To this end Robertson and Gatignon (1986) state that "researchers familiar with diffusion theory within marketing will recognize that supply-side factors have not been pursued in diffusion research" (p.2).

This lack of research on supply side factors has resulted in a limited knowledge of their influence upon the adoption response of firms and moreover, in a confusion of what really supply side factors represent. Therefore, this chapter will attempt to illuminate the spectrum of supply side factors and to investigate a number of them.

Despite the lack of research in this area, the author holds the opinion that insights developed mainly in the field of success and failure of new products as well as, in other salient fields of inquiry (e.g. sociology, industrial economics, industrial buying behaviour), can provide useful guidelines for advancing the yet limited knowledge in this field. As such, this chapter is divided in two sections. Section one, reviews research findings from studies on the success and failure of new products and discusses their relevance with the present topic. Successively, section two investigates in detail specific issues with regard to the impact, upon the adoption response of firms towards an innovation, of factors related to the supply side of this innovation.

SECTION 2.1. : SUCCESS AND FAILURE OF NEW PRODUCTS

Despite of their strategic importance new products are plagued by an unacceptably high failure rate (Crawford 1977,1987, Cooper 1981, Booz Allen and Hamilton 1982). Some years ago Crawford (1977) remarked: "we have 50 years of technological development, a growing body of psychological and mathematical hypotheses, a reasonably complete literature, excellent journal, an eminently successful association (AMA), a solidly established educational system and a collection of practitioners which would compare favorably with that of any profession. Why, then, do we have such a high rate of new products failure?" (p.52). The high failure rate has provided the impetus to empirical research in the field. The purpose of those studies is to identify the likely causes of failure as a basis for diagnosis, prognosis and, hopefully, cure (Baker 1975a). Indeed, as Cooper (1979b) notes, many of the variables that might separate the 'winners' (successes) from the 'losers' (failures) are within the control of the firm, and a knowledge of what these variables are and their relative importance, would lead to corrective actions towards improving the way firms develop and launch new products.

The empirical research in this area can be divided into four directions. The first direction includes a number of studies that investigated new product successes aiming at finding the common ingredients of success (see, inter alia, Mayers and Marquis 1969, Langrish et al. 1972, Globe et al. 1973, Roberts and Burke 1974, Booz Allen and Hamilton 1982). In the second direction attempts have been made towards the identification of the reasons for failure, premised on the argument that it is easier to diagnose 'what went wrong' than it is to find 'what went right' and that a critical analysis of past failures is the first step towards prescriptive solutions (Cooper 1980a, see also, Colantone and Cooper 1979). The third direction has focused on comparing and contrasting successes versus failures as the key to identifying factors that separate the two (see, inter alia, Rothwell et al. 1974, Cooper 1979a, 1979b, Souder and Chakrabarti 1979, Link 1987, Parkinson 1984). Finally, recent research efforts have postulated the importance of the strategic aspects of the new product development and commercialization process, in an effort to indicate the way in which a strategic orientation can affect the success or failure of innovations (see, inter alia, Bennet and Cooper 1981, Crawford 1980, Cooper 1985).

A common characteristic of these studies is that information are derived not from the population of adoptors or non-adoptors of an innovation but from the innovating firms i.e. the firms that have produced the innovations. In that respect researchers have been able to identify the characteristics of innovative or technically progressive firms and to associate them with the successful or unsuccessful performance of their new products.

The aim of this section, therefore, will be to investigate the factors that have been found to influence the success or failure of new products. It must be stated here that the purpose of this section is not to doubt the validity of the findings reported in these studies, but by critically reviewing them, to get useful insights for the study of supply side factors and their influence upon the adoption of innovations.

2.1.1. NEW PRODUCT SUCCESS VERSUS FAILURE

To begin with, the studies by Mayers and Marquis (1969), Langrish et al. (1972), Globe et al. (1973), Roberts and Burke (1974) can be cited, among others, as early attempts to identify a new product success formula. Their most common factor for success was the recognition of a need or demand for the new product.

With regard to new product failure, Baker (1975) has quoted a survey undertaken by the National Industrial Conference Board (NICB) in 1964. In this survey 87 industrial product were examined and the following reasons for failure were identified:

1. Inadequate market analysis
2. Product defects
3. Higher costs than anticipated
4. Poor timing
5. Competitive reaction
6. Inadequate sales force
7. Insufficient marketing effort
8. Inadequate distribution

By comparing the above reasons for failure with those identified eight years later by Foster (1972), Baker concluded that they can be reduced to two fundamental causes of failure: a) inadequate knowledge of market conditions and b) managerial incompetence. Some years earlier, Webster (1969), had postulated the following reasons for new products failure:

1. Failure to define precisely that segment of the market where the product is likely to have greatest value for users.
2. Underestimation of the amount of marketing effort required to generate the expected revenue level.
3. Failure to anticipate the demand which the new products make on customers' technical and application skills.
4. Underestimation of the amount of new investment required on the part of customers and the extent to which present production technology is made obsolete.
5. Inadequate understanding of the buying process and influence patterns within customer organizations leading to underestimation of the amount of time required for evaluation and trial by each customer.
6. Lack of awareness of existing relationships and influence patterns between prospective customers and their present vendors as well as relationships and influence patterns among members of the customer's industry.

Clearly, Webster's suggestions shift the point of interest from the general 'understanding of buyer needs or inadequate market research' to a more specific understanding of the target market, the prospective buyers and their buying process. His ideas enjoyed early empirical support from Reekie's (1971) study, where it was found that technically successful new products were dropped mainly because of an unattractive small market and lack of marketing capacity or expertise.

Concerning studies contrasting innovations successes with failures, the British SAPPHO[8] project is one of the most frequently cited ones. This project sought a pattern of differences between a sample of pairs of commercially successful and unsuccessful industrial products in the industries of chemical processes and scientific instruments. By using the aggregated data from both industries the following 5 factors were found to discriminate between successes and failures (Rothwell et al. 1974): **1.** Successful innovators have a much better understanding of user needs. **2.** Successful innovators pay more attention to marketing and publicity. **3.** Successful innovators perform their development work more efficiently than failures but not necessarily more quickly. **4.** Successful innovators make more use of outside technology and scientific advice in the specific area concerned. **5.** The responsible

[8] Project SAPPHO : Scientific Activity Predictor from Patterns with Heuristic Origins.

individuals in the successful attempts are usually more senior and have greater authority than their counterparts who fail.

The equivalent to project SAPPHO in Britain is the Cooper's project Newprod in Canada. Cooper (1979a, 1979b) studied 102 success and 93 failure projects in 103 Canadian industrial firms and developed a model for new product outcome. According to that model the new product process yields a "commercial entity", whose fate is determined in the marketplace. Cooper, used in his research 77 variables to describe the new product development. These variables were reduced to 18 dimensions leading either to success or failure. Of the above 18 dimensions, three were decisive to project success: **a)** Product uniqueness and superiority, **b)** Market knowledge and marketing proficiency,; and **c)** Technical/ production synergy and proficiency, three were characterized as barriers to success: a) having a high priced product, relative to competition, **b)** being in a dynamic market with many new product introductions, and **c)** being in a competitive market where customers are already satisfied, and three were found to be facilitators of the new product success: **a)** Marketing and managerial synergy, **b)** Strength of marketing communications and launch effort, and **c)** Market need growth and size.

According to Cooper (1980a,1981) a high success rate demands the existence of all the above three decisive dimensions requiring a multidisciplinary, multifunctional approach to the process of new product development and commercialization. In the second facet of the project Newprod, Colantone and Cooper (1981), investigated 195 new product cases and identified 9 scenarios which indicated strong tendencies to either success or failure. According to them, the "Synergistic 'Close to Home' Product" scenario yielded the highest success ration i.e. the ratio of the proportion of successes in the group to the proportion of successes in the entire sample.

In another study Cooper (1983a), examined the mean duration time of a number of activities (20) during the new product development process of 58 products (30 successes and 28 failures), in 30 industrial companies. By contrasting those typologies to the success ratio of the new product projects and to a number of firms characteristics he found that, the "balanced complete process" was the most successful typology. This included most of the activities prescribed in the new product development and had a balance between marketing and technical activities throughout the process. According to Cooper, the success of a new product clearly depends to a large extent on the process by which it is developed and launched. These results coincide as to those reported by Cooper & Kleinschmidt (1986) from the second phase of project Newprod.

Similar to the projects SAPPHO and Newprod is also the study conducted by Maidique and Zirger (1984). They examined a large number of industrial new product successes and failures in a multi-stage study which employed an open-ended survey, a structured survey and case studies. The factors cited by the respondents as influencing the new product development process commercial outcome were categorized as: **a)** environmental variables, incorporating market and economy characteristics as well as government regulations, **b)** Corporate skills and resources and **c)** product characteristics and product strategy.

Although the above lists of factors influencing the success or failure of innovations are somewhat different, they do appear to have two factors in common, namely marketing and technical expertise.

Finally, in a study of unsuccessful British companies and successful West German companies, producers of high technology machine tools, Parkinson (1984) attributed the success of the latter mainly to their heavy interaction with their customers, as well as with Universities and Research Institutions during the new product development process.

2.1.2. NEW PRODUCT STRATEGY

Although the new product studies regarding the success and/or failure of new products have revealed much about the "winning" new product, their focus on individual products rather than the totality of the company's new product programme has been criticised as myopic (Bennet and Cooper 1981, Gold 1980). Indeed, what leads to success for individual products may not result in a totally successful new product programme (Cooper 1983b). The tremendous consequences of a major new product failure for a firm, call for the full recognition of the strategic importance of the new products. As Kantrow (1980) noted, new product development and technology bear an integral relationship to a company's strategic thinking by helping to define the range of that company's choices. Recently researchers have begun to probe the company's new product programme and the performance results of the entire new product programme. Booz, Allen and Hamilton's (1982) study concluded that the companies which are most likely to succeed in the development and launch of new products are those firms which implement a company specific approach driven by corporate objectives and strategies, with a well defined new product strategy at its core.

Among the first authors to postulate the issue of new product strategy was Crawford (1980). He developed the "Product Innovation Charter" (PIC), which is a document that can give comprehensive direction to all of a business unit's new product activities, an eventual "must" for all firms (Cooper 1987). The main dimensions of the PIC, as produced from a study of 125 consumer and industrial firms, were related to :

A. "The target business arena".
B. "The goals or objectives of product innovation activities".
C. "The program of activities chosen to achieve the goals and objectives".

Following Crawford's identification of the key dimensions that constitute a new product strategy, Cooper in Canada and Nystrom in Sweden attempted to investigate how various new product strategies were tied to performance. Nystrom (1979) studied a number of companies in the farm machinery, food processing and paper industries and found six strategic dimensions of firms' R&D programmes. He concluded that new product strategies emphasizing synergistic use of technology, a responsive R&D organization and an externally oriented R&D effort were generally more successful. Cooper's study (1985) which involved 122 industrial goods companies defined a company's new product strategy in terms of a) new products developed; b) the technology employed; c) the type of new products sought; d) the orientation and commitment to the new product programme. It also uncovered five different new product strategy types. One of those strategy types - the Balanced & Focused - was found to have exceptional results relative to all the others. Firms which pursued that type of strategy were separated from all the others according to the following issues (Cooper 1984a,1984b):

1. They had a unique programme orientation:
 - a strongly marketing oriented and marketing dominated programme;

- technologically sophisticated, oriented and innovative;
- a highly focused programme;

2. They selected certain types of markets:
   - non-competitive markets;
   - high-potential, high-growth markets;
   - markets with no dominant competitors;
   - markets that the firm had served before;

3. They developed certain types of products;
   - products that closely fit into their current product line and were closely related to each other;
   - premium priced products;
   - products with two types of differential advantages: quality and superiority, and customer impact and features;
   - standard and not custom products.

Johne (1984b,1987), studied the innovation records of 16 instrument manufacturing firms by developing a schema for categorizing them as "leaders" and "followers" (Johne 1984c) according to their product innovation performance. He found, among other things, that leader companies where different to followers with regard to their corporate strategy i.e. leaders had a clear desire to lead the market by product innovations.

Recently, Johne & Snelson (1988a) investigated the program success of a number of firms by means of the McKinsey's 7 S's framework, based on the premise that it can be used as a common analytical framework for "exploring the intricacies of product development" p.227. They found significant differences between successful and less successful innovating firms with regard to their strategy dimension, as well as to the rest of the 'Ss' of McKinsey's framework, and suggested its use as an "audit" mechanism of new and old product development programmes (Johne & Snelson 1988b,1989).

2.1.3. THE RELEVANCE OF THE SUCCESS VERSUS FAILURE STUDIES WITH STUDIES IN THE ADOPTION AND DIFFUSION OF INNOVATIONS

To illustrate the relevance of the above studies with studies in the adoption and diffusion of innovations stream of research, one has to bear in mind the following question:

'Does success of an innovation or innovations, as it has been conceptualized in the above studies, indicate a high rate of adoption & diffusion for this innovation in its relevant market?'

Clearly, if the answer is 'yes', then the above studies have contributed substantial insights to the process of adoption and diffusion. Alternatively, if the answer is 'no', the results of the above studies are pertinent only to the firms which produce innovations. Obviously, the latter limits the applicability of their findings and suggestions but in no way undervalues them.

To answer the above question one has to consider and compare the objectives of each strand of research as well as the different measures used to denote the dependent variable or variables in the relevant studies and the targeted population.

Concerning the objectives, both research traditions have been used in the marketing discipline aiming at assisting firms to plan and execute the development, as well as the marketing of their innovations. In the case of adoption and diffusion research, observations in the targeted industry provide the means to draw conclusions regarding the critical factors for the marketer to consider. In the case of success and failure, observations in the industry producing the innovation and evaluation of the opinions of the producers are used to identify the factors that the marketer should take into account. Having said that, one can reasonably argue that the difference is not upon the objectives. Rather it lies upon the methodologies used.

With regard to the measures of the dependent variables used in the two research traditions, in the adoption and diffusion research mainly three different measures have been used: a) time (speed) of adoption of an innovation or multiple innovations by a firm or multiple firms, b) number of innovations adopted by a firm or multiple firms, c) number of firms that adopted a specific innovation, and d) number of firms that adopted an innovation as opposed to the number of firms that have not adopted it. Despite the different conceptualization of the dependent variable, a review of the literature on the adoption and diffusion of innovations shows that results from each direction are used interchangeably from the others.

In regards to the research on the success and failure of innovations the dependent variable of "success" has been determined in many ways such as:

a) a totally subjective estimation by management,
b) technical success, which denotes the successful development of a product in the laboratory,
c) commercial success, which indicates the innovation which obtains a worthwhile market share and profit (Rothwell et al. 1974),

d) financial success, and

e) more elaborate measures of success as they have been developed by Cooper (1984c),and Cooper & Kleinschmidt (1987)[9] which include the concept of both financial and commercial success.

Despite differences in the above measures the notion of market share is included, implicitly or explicitly, to the majority of them. Thus, with a considerable degree of confidence one can claim that an innovation which enjoys a large share in its relevant market can be characterised as a success. But a large market share for a specific innovation (successful) indicates that this innovation has been adopted (diffused) in the industry to a high degree. Similarly, Baker (1975) stated that "...it is clear that the speed with which a new product can gain acceptance is a critical determinant of whether it will be a success or otherwise" (p.xi). Thus, one might reasonably argue that both research directions aim at the investigation of the factors that influence the performance of that innovation in the market place. In the first research direction this performance is denoted by the 'commercial success' of the innovation. In the second direction however, it is depicted under the headline 'rate of adoption and diffusion'. Without any doubt numerous arguments can be raised against the above statement, but the author believes that the majority of them exist due to shortcomings identical to each research direction. Certainly such counter arguments are of great importance since they can initiate thoughts towards the remedy of any deficiencies. But at present they must not prevent one from realizing that there is room for integration which can advance the current knowledge regarding the entire innovation process and the influence upon adoption and diffusion of factors related to the supply side of the innovations.

The lack of consideration of supply-side factors affecting diffusion has been noticed firstly by Gatignon and Robertson (1985) in the consumer research tradition. In their consumer

[9] Cooper and Kleinschmidt, claim that if managers focus only on the ingredients of financial success the result is likely to be a "myopic" new product effort. This is along the lines of Hayes and Abernathy (1980) who made a strong case that a preoccupation with short term financial performance measures has hurt American business. Cooper and Kleinschmidt introduced a "multidimensional" concept of success. The three dimensions which have been produced by a factor analysis of 10 measures of new product performance are: 1) "Financial performance". Represents the overall financial success of the project. 2) "Opportunity window". Portrays the degree to which the product opened up new opportunities to the firm in terms of a new category of products and a new market for the firm. 3) "Market share". Describes the impact of the product on both domestic and foreign markets.

diffusion model, which was an extension of the one proposed by Rogers, they added two new influential factors: a) the role of the competitive actions; and b) the role of the marketing actions, which they clearly linked to the notion of the change agent. Replicating their ideas in the industrial diffusion research tradition (Robertson & Gatignon 1986), they noticed that: "existing research tends to ignore how supply-side competitive actions change the diffusion process" (p.3).

Gatignon and Robertson (1985,1986) stated that they perceived and suggested their industrial diffusion model mainly due to the insights gained by their attempts to integrate recent empirical evidences and especially those developed in the diffusion modelling domain by authors such as Bass (1969), Horsky and Simon (1983), Lilien, Rao and Kalish (1981), Simon and Sebastian (1987), Mate (1982), Rao and Bass (1985), Thompson and Teng (1984). However there is no attempt to integrate the empirical evidence from the success and failure of innovations with those of the other research traditions of innovations. Yet it is evident that Gatignon and Robertson were well aware of the developments of these studies. In their major articles in Journal of Marketing and Journal of Consumer Research they do cite at least the work of Cooper. I believe that their lack of attention to this stream of research resulted mainly from their clear depreciated view of this research which they characterise as oriented towards product/innovation characteristics associated with successful or unsuccessful market entry.

However, a careful examination of the factors investigated in the success versus failure studies indicates that these attempts have followed a more 'holistic' approach towards innovations than that of adoption/diffusion studies. The variables which are investigated cover a wider range of the entire innovation process. Indeed, the latter studies start only after the first adoption of the innovation, concentrate on the market where diffusion takes place and ignore totally not only the suppliers of the innovations and their actions but also the competitive conditions in the industries of the adopters.

The author holds the view that, the thoroughness of the former studies combined with their remarkable consistency as to the major factors underlying success or failure of innovation provide the missing link of the adoption/ diffusion studies. Their outmost common finding is the fact that, although the successful performance of an innovation is a very complex issue to be achieved, it is heavily dependent on management's actions. According to Cooper's own words: "it matters not what situation you face; it matters more what you do about it!" (Cooper 1979a,1980b, p.135). This final point clearly demonstrates the decisive role of the producers or suppliers of an innovation for the performance of the innovation in the market place.

Regarding supply side factors it is important to note that diffusion modellers have primarily tackled the influence of marketing mix variables upon diffusion and of the competitive conditions inherent in their industry. In contrast researchers of success and failure of innovations have additionally incorporated in their investigations supply factors relevant to the entire innovation process. Previously reported studies in this chapter indicate that the performance of an innovation in the market place depends upon factors such as the objectives and the orientation of the producing firm, its technical and production strengths and capabilities during and after the development process, its reputation, culture, organizational structure and overall managerial skills. Thus, it is clear that producers and suppliers are voicing their influence on the diffusion of an innovation intentionally or unintentionally, not only through its marketing. Despite such developments in the success vs failure studies long ago, adoption/diffusion researchers only recently have started to appreciate them and suggest their inclusion in diffusion studies. To this direction can be cited the work of Robertson and Gatignon (1986), Mahajan et al. (1990), Sultan, Farley & Lehmann (1990).

Finally of great importance is the difference in the measures used to indicate the supply side factors in success vs failure studies and in diffusion studies. Diffusion researchers and modellers use quantitative measures such as amount of resources allocated for R&D, for advertising and promotional efforts. This, eventually, provide little information to the industrial marketer or any other unit that wishes to manipulate specific functions of a firm in order to speed up the adoption & diffusion process of an innovation.

Although such measures have been implemented also in success vs failure studies these researches have reached one further step. More precisely these studies deal with knowledge, skills, synergy and proficiency of producers in undertaking specific decisions and activities during the innovation development and adoption & diffusion process. Clearly this qualitative interpretation provides a deeper understanding of the factors that really influence the diffusion of an innovation. For this additional reason these studies are very important for advancing the knowledge of the way that supply side can influence the diffusion of an innovation.

2.1.4. SOME LIMITATIONS

In the preceding parts of this section a large number of studies on the success versus failure of innovations have been reviewed. In addition, the way in which their results can be used to advance the knowledge and the research efforts on the adoption and diffusion of innovations has been assessed. However, these studies suffer from some limitations, which need to be acknowledged and taken into account before any systematic attempt of capitalizing on their findings in future research efforts.

One limitation is the fact that these studies have examined the new product development performance of different firms without any provision of whether these products were really innovations or not. The Booz, Allen and Hamilton study in 1982 identified the following six types of new products in terms of their newness to the company and to the marketplace: **1.**New to the world (10% of total new introductions) **2.**New product lines (20% of total) **3.**Additions to existing product lines (26% of total) **4.**Improvements/revisions to existing product lines (26% of total) 5.Repositionings (7% of total) **6.**Cost reductions (11% of total)

The same study revealed that over the past 5 years more than 50% of the companies surveyed have not introduced any new-to-the-world products, while more than 25% of the companies introduced no new product lines. These figures confirm that the products used in the success vs failure studies were not all innovations. Furthermore it is evident that different new product types have different success and failure rates, varied degrees of development and market related risk and serve different objectives (BAH 1982). Finally recent research efforts postulate that different types of product (new-old) developments require different marketing skills in order to be successful (Johne & Snelson 1988c). In addition the products surveyed in these studies were mainly chosen by the producers and according to their perceptions of the products' newness. In contrast the newness of a product in adoption/diffusion studies corresponds to the customers' perceptions and it is assessed by experts in the industry or field of the innovation.

Another limitation is raised by the fact that in the above studies information are provided only by the producers of the new products and not by the actual buyers. However, recent research efforts have found that the explanation regarding product failures given by buyers and sellers are different (Folkes & Kotsos 1986). In addition according to Folkes (1984) different attributions to product failure can lead to different beliefs about redress and thus, to conflict. Therefore, a promising way for a researcher, to overcome the above problems, is to compare and contrast (where feasible) the perceptions of the producers with those of the customers.

Having in mind these limitations, the next section utilizes the above literature, alongside empirical evidence from other salient fields of inquiry, and attempts to outline the spectrum of supply side factors and their influence upon the adoption response of firms.

SECTION 2.2. : SUPPLY SIDE FACTORS

Among the first authors to address the influence of supply side factors in a diffusion model is Robertson (1984). Specifically, in an article in the journal of Advances in Consumer Research 1984, Robertson postulated that "diffusion theory is incomplete unless it recognises the proactive nature of marketing and competitive actions...marketing actions by their very nature are designed to change the diffusion process to the firm's advantage" (p.486). In the same article, he provided many useful insights of the way in which the marketing of an innovation and therefore the supply side impacts on its diffusion in the market place. These early and general suggestions took the form of a specific "propositional inventory" for new consumer diffusion research in a later article in the Journal of Consumer Research (Gatignon and Robertson 1985).

However, there is a clear difference between the two articles. In the first one Robertson (1984) sustained a much wider impact of the supply side upon diffusion. Its influence was exercised not only through the marketing actions during the adoption and diffusion period but also through the supply side activities during the development of the innovation. He stated that "the role of marketing actions begins with the very concept of the innovation...it is not sufficient for consumer behavior researchers to study consumer reactions after product introduction and to ignore the before introduction research which created the product" (p.486).

In the second article the role of the supply side was diminished and implied only the marketing-mix activities and the competitive environment during the adoption and diffusion process.

Following their attempts to take into account supply side factors into the adoption and diffusion of consumer products, Robertson and Gatignon (1986) developed a similar diffusion model for industrial products. This model takes into account explicitly the supply side activities, the suppliers' competitive environment and the adoptors' industry competitive environments as influential factors of the adoption and diffusion process of industrial innovations. According to Robertson and Gatignon it is a competitive diffusion paradigm since, a) the marketing-mix variables, indicating the suppliers' marketing activities, "in a sense are competitive variables since their levels are determined relative to competitive levels..." (p.1); and b) the condition inherent in current research, which assumes that only one firm is supplying the innovation, rarely holds.

Building on empirical evidence, provided mainly from fields such as economics and the diffusion modelling domain, Robertson & Gatignon (1986) maintain that the structural characteristics of the suppliers' industry and the industry's allocation of resources to the new technology affect the speed of diffusion and the total market potential realised.

Despite the unquestionable value of the above paradigm, for the conceptualization of supply side factors and their effects upon adoption and diffusion, there are a number of issues that deserve further attention.

1. It is important to notice that Robertson and Gatignon perceive the role of the supplier as a 'persuader'. Robertson (1984), maintained that "the diffusion theory assumes a certain passivity...yet, the marketing actions by their very nature are designed to change the diffusion process to the firm's advantage" (p.486). Therefore their inquiry of the suppliers' role is oriented towards the suggestion that "the more an account is targeted and aggressively marketed by suppliers, the more likely a sale" (Gatignon and Robertson 1989, p.43). There is a danger here that their emphasis on suppliers' activities may lead to a perception of the diffusion process as a one-way persuasion, which ignores the dynamics of the diffusion process. Rogers (1983) suggests that: "persuasion and thus diffusion as a communication activity is not something one person does to another but something he or she does with another" (p.xvii).

2. Robertson and Gatignon make some references to the role of marketing research and the customers during the development process of the innovation. However they do not take into account explicitly the influential role of these and other pre-launch activities on the subsequent diffusion of the innovation.

Therefore their diffusion paradigm is susceptible to Rogers (1983) criticism that: "The importance of what happens prior to the beginning of an innovation's diffusion (especially those events that affect the nature of diffusion later on) has been almost entirely ignored in past diffusion studies" (pp.134-135)

Supporting empirical evidence to the above is provided by Cooper (1979b) who found that the activities during the new product development process determine to a great extent the success or failure of an innovation in the market place.

3. The Robertson and Gatignon's diffusion paradigm is theoretically based on the competitive behavior of firms but there is a clear limitation of its applicability to only marketing-mix suppliers' tactical decisions. In contrast Weitz (1985) suggests that "long term strategic marketing decisions require a broader definition of competitors and customers -product markets or industry segments - so that unserved potential needs and competitive threats are identified" (p.230). Strategic marketing decisions also can influence dramatically the speed of diffusion. Recently there has been a growing body of literature in marketing and management tackling strategic issues of new technology (Ford & Ryan 1981, Capon and Glazer 1987, Ford 1988, Clarke et al.1988).

4. Robertson and Gatignon (1986), maintain in their competitive paradigm that the structural characteristics of the suppliers' industry affect the speed of diffusion and the market potential realised. Their thesis is in accordance with Weitz's (1985) remarks for the stance of marketing's research within the dominant industrial organization paradigm, structure-conduct-performance. Weitz states that marketers are more interested with the performance of firms and products than with the performance of industries as a whole. Therefore marketers have concentrated on the conduct or behavior of competing firms and not with the structural properties that affect conduct, the latter being a major concern for the economists (Willard and Cooper 1985).

However this aggregated level of analysis is not sufficient by itself to explain the way in which supply side industry specific factors influence the adoption and diffusion of innovations. Indeed empirical evidence from industrial buying behavior research indicates that the final decision to adopt an innovation is taken only after evaluation of the product and the firm producing it (Shaw et al.1989). Therefore the next necessary level of analysis is the nature of the supplier's activities and its products. In addition as Shanklin and Ryans (1984) postulate the introduction of new technology is capable of creating and revolutionalising markets and demand, thus changing the very structure of the industry.

5. Finally, it is peculiar that Robertson and Gatignon while drawing their propositions tended to ignore the relevant empirical evidence provided from studies on the success versus failure of innovations and industrial buying behavior and purchasing. Insights gained from the latter field can be used as a benchmark against which, the pervasive influences of the suppliers' activities in the adoption and diffusion process, can be judged.

Armed with the above insights one can now proceed to assess the wider spectrum of supply side factors that affect the adoption response of firms towards an innovation.

2.2.1. THE WIDER SPECTRUM OF SUPPLY-SIDE FACTORS INFLUENCING ADOPTION RESPONSE

The different blocks of supply side factors affecting the adoption response of firms are illustrated in the following Figure 1.

In line with the above discussion a schema of supply side factors is presented which includes both factors mediated by the industry as a whole, and firm specific factors which represent the activities of the suppliers. Furthermore, it is suggested that the properties of the suppliers' industry can influence adoption directly, or indirectly by initiating firm's specific activities. In addition firm specific factors are distinguished into pre-launch activities and activities during the adoption and diffusion of the innovation. In this respect the processes of innovation development and diffusion are conceptualised as a continuous one and the actions of suppliers are sought on a continuum basis.

FIGURE 1: Supply Side Factors Affecting Adoption Response

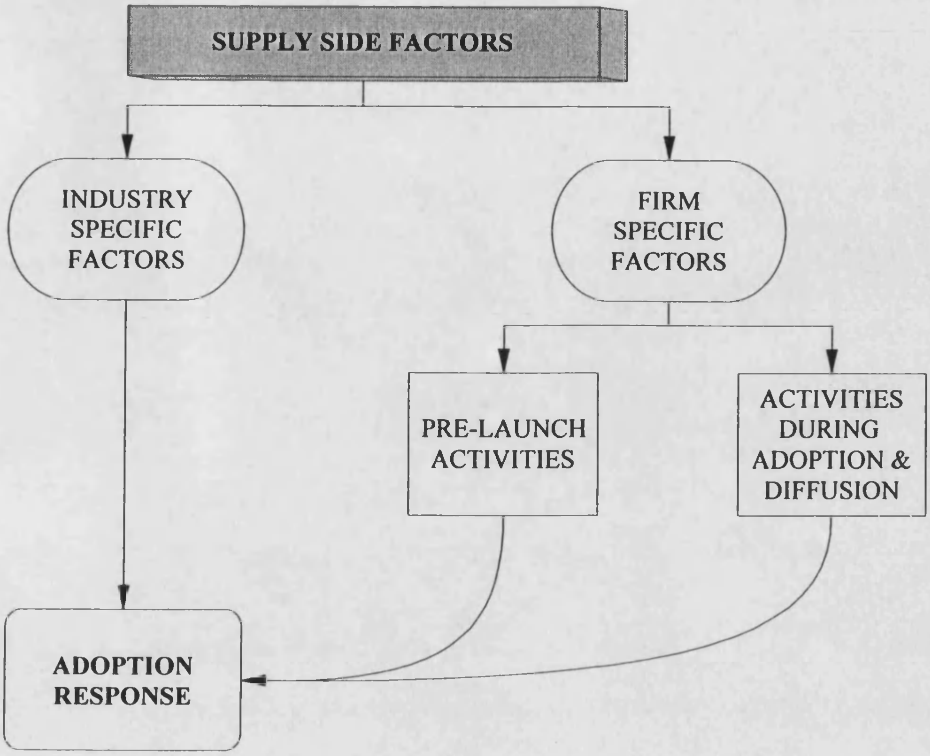

Table 3.1 provides a description of the different blocks of supply side factors alongside the research field or researcher that postulated their existence. As it can be seen supply side factors have been pursued in many research fields and therefore the following discussion will attempt to integrate findings from individual studies and from different fields of research.

Table 3.1.: Supply Side Factors Affecting Adoption & Diffusion

	Supply Side Factors Affecting Adoption and Diffusion		
		Firm Specific Factors	
Authors and/or Research Traditions	Industry Specific Factors	Pre-launch Activities	Activities during the Adoption and Diffusion of the Innovation
Rogers in Sociology	-----------	Technology Gatekeeping	Activities of the Change Agent
Rothwell in Success vs Failure Studies	-----------	Efficient Development & Elimination of Defects Before Commercial Launch Understand User Needs Familiarity with Market Conditions	Pay Atttention to Marketing Pay Attention to User Education Pay Attention to Publicity Employ large sales force
		Good Internal and External Communication	
Cooper in Success vs Failure Studies	Being in a Dynamic Market (-) Being in a Competitive Market (-)	Producing a Unique and Superior Product Technical and Production Synergy and Proficiency	Strength of Marketing Communication and Launch Effort
		Market Knowledge & Marketing Proficiency Marketing and Managerial Synergy	
Diffusion Modellers in Marketing	Multi-Innovation Diffusion Models (Influence from other Innovations) Competitive Diffusion Models (Competitive actions in terms of Pricing, Advertising and number of Brands)	Controlled Diffusion Models (Effects of Supply Restrictions)	Diffusion Models with Marketing Mix Variables: Effect of Price, Advertising, Personal selling, Distribution, and timing of new product introduction on diffusion patterns
Robertson and Gatignon in Marketing	Industry Competitiveness Technology Standardization		Marketing Support Supplier's Reputation
	Vertical Coordination with Customers R&D Allocation		
Industrial Buying Behaviour & Purchasing	-----------	-----------	The role of Marketing Product and Supplier Evaluation

2.2.2. *INDUSTRY SPECIFIC FACTORS*

Robertson and Gatignon (1986) maintain that, among other things, structural properties of an industry such as competitiveness, reputation, technology standardization, R&D resource allocation and vertical coordination, affect the speed of diffusion. Their thesis is that such conditions influence diffusion by mediating awareness, receptivity and confidence to the products of the industry among potential adoptors. They are capable of increasing the value of the innovation to the adoptors and to drive down the prices thus, allowing from a cost point of view the adoption of the innovation.

Such structural properties of the suppliers' industries can be very important in explaining variation in adoption and diffusion rates for competing innovations developed by different industries or different segments within the same industry (substitutes), or even industries from different countries. Further useful insights for the pursue of this research can be found in industrial economics (technology transfer), as well as in strategic management and marketing (Mansfield 1968, Pavitt 1983, Chasin and Jaffe 1979).

However, as it was mentioned above, this aggregate level of analysis cannot easily explain differences in the adoption and diffusion rates of innovations developed in the same industry. To this end a second level of analysis is needed which will enquire into the nature of the activities of specific suppliers. In other words these activities represent the conduct of firms in the industry which is largely mediated by the industry's structural properties. The following discussion will investigate a number of such activities.

2.2.3. *THE NATURE OF THE ACTIVITIES*

2.2.3.1. *TECHNOLOGY STANDARDIZATION*

According to Robertson and Gatignon (1986) "the sooner the industry attains standardization on a dominant design the more rapid the diffusion process, since customers will be more receptive to the innovation as the perceived risk for buying the wrong standard declines" (p.4). However Katz and Shapiro (1983) found that a firm with a dominant position in the market may deliberately decide to be incompatible with the products of a rival because compatibility would increase the value of its rival's products to the consumer. Besides, Farrell and Saloner (1985) maintain that standardization can cause reduction in variety and impede the switch from a common standard to a possibly new standard or technology due to the coordination problems involved.

Since an innovation, at its early stages of introduction, is a non-standard product by definition, the potential early adoptor faces the risk of buying the wrong standard. He manages that risk by means of careful examination of the other properties of the product and the supplier (Shaw et al. 1989) and by the first mover advantages he might achieve from what he expects to become an industry wide standard (Farrell and Saloner 1985). Therefore standardization is more relevant to late adoptors and laggards who adopt only after a certain degree of diffusion (thus standardization) has been achieved in the industry.

2.2.3.2. R&D ALLOCATION

Robertson and Gatignon (1986) maintain that greater expenditures on R&D by supplier firms will result in more advanced technologies and more technological alternatives which in turn will increase the attractiveness and applicability of the innovation to the potential buyers and, therefore, more rapid and broader diffusion will be achieved. Supporting evidence is provided indirectly, by Mansfield (1986) and McGuinness & Little (1981). However, Cooper (1979b), among others, found that technological superiority of a product cannot ascertain its commercial success. This can only be achieved if the technological capabilities of a firm are well integrated with marketing proficiency and customer orientation.

2.2.3.3. COMPETITION

In consumer markets Gatignon & Robertson (1985) suggested that when there is differentiation among brands, greater competition has a positive effect on primary demand. Regarding industrial products they maintain that lower prices driven by intense price competition are capable of increasing the adoption and diffusion rate of an innovation (Robertson and Gatignon 1986). However, in an industrial setting differentiation among products is the rule and not the exception. Moreover, industrial buying behaviour suggests that price is one, and not the most important, of the many criteria employed by buyers in their adoption decision (Shaw et al.1989). Again, Cooper (1979b) found that market dynamism (i.e. frequency of new product introduction) and market competitiveness (i.e. intense price competition and many competitors) are obstacles to the commercial success of new products.

Robertson and Gatignon (1986), maintain that in the industry of adoptors "the relationship between competitive intensity and innovation receptivity is probably curvilinear...reasonable levels of competitiveness encourage the acceptance of innovations, but beyond some point, the financial resources of the industry are depleted and the acceptance of innovations is stifled" (p.7). It is believed here that the same proposition holds for the suppliers' industry too. Intense price competition engages companies in ruthless 'price war' and extinguishes valuable resources which otherwise would have gone to R&D or marketing activities. By the same token, intense competition in product features might result to many 'me-too' products (Cooper 1979b) which in turn might force the potential buyer to postpone his decision to adopt the product expecting an even better one to be produced (Antonelli 1989). Finally, intense competition in associated services might shift the orientation of the producer and deviate his resources from R&D to marketing and promotional activities. This is expected to result into inferior products; a fact which will have a negative impact upon the adoption response of firms.

2.2.4. PRE-LAUNCH ACTIVITIES

The pre-launch period of an innovation has been conceptualized by many authors as a period of action and continuous planning for the supplier. It includes mainly the activities of the supplier towards the development of the innovation (NPD activities) and the plans on which the commercialization process of the innovation is going to be based (Rogers 1986, Robertson 1984).

2.2.4.1. NEW PRODUCT DEVELOPMENT ACTIVITIES

To begin with, Robertson and Gatignon (1986) postulated that the suppliers of an innovation affect the adoption and diffusion rate, among other, through their actions when determining the characteristics of the innovation. From another point of view, research on industrial buying behavior identified the decisive role of the product characteristics on the adoption decision (see Chapter 3). These empirical findings justify the initial statement by Robertson and Gatignon but in terms of the present discussion hold little theoretic value. Indeed, they don't provide any guidelines to the prospective researcher of the way in which he can develop and test hypotheses relevant to the impact of the NPD activities on the adoption response of firms.

Primarily, the above difficulty results from the fact that these studies take the innovation as a given and study, mainly, the compatibility of the innovation (in a broad sense) with the potential buyers perceptions and conditions leading to an adoption decision (Robertson and Gatignon 1986). Therefore they fail to see the dynamics of the new product development process through which a general and abstract idea becomes a specific product. It is the quality of this process that configurates to a large extent the chances of success for the new product and its successive adoption and diffusion rate in the market. According to Robertson (1984) "it is not sufficient for the consumer behavior researchers to study consumer reactions after the product introductions and to ignore the before introduction research which created the product" (p.486). To this end ample empirical evidence demonstrate, implicitly or explicitly, that technical proficiency and close interaction and/or communication with customers and outside sources of scientific knowledge (universities, research institutions etc.) are prerequisite properties of a successful product's development process (BAH 1982, Parkinson 1984, Roberts and Burke 1974, Maidique and Zirger 1984, Souder and Chakrabarti 1979).

The following discussion will substantiate the relevance of these factors in the adoption response.

2.2.4.1.1. TECHNICAL/PRODUCTION PROFICIENCY

This factor affects adoption in several ways. Firstly, it secures the efficient development of a product through the application of advanced technology. In this way the odds are greater for the product to be unique, superior to its competitive ones and in general equipped with mechanical and operational features that provide advantages to prospective buyers. Empirical evidence demonstrate that accomplishment of such features do speed up the adoption and diffusion of an innovation (Hayward et al.1976).

Secondly, technical & production proficiency is capable of eliminating any defects during the development process and before the commercial launch. Empirical findings suggest that defects and problems in the development process can undermine the customers confidence and if left undetected after the commercial launch can severely harm the diffusion prospect of the innovation (Rothwell 1977).

Thirdly, technical and production proficiency can act as a risk reduction mechanism to the potential adopters thus speeding up the adoption and diffusion. Indeed, the inability of the potential adopters to comprehend fully the technological properties of an innovation through product evaluation, especially if it is a radical one, forces them to an evaluation of the supplier's technical capabilities and its operations viability (Abeele and Christiaens 1986, Hawes and Barnhous 1987). Besides, technical proficiency of the supplier increases the confidence of the adoptor that he is able to cope with any technical difficulties with the product in the future, if required. Also, it increases his confidence that the supplier will be capable of upgrading his product by the application of any new technology and whenever it appears (Shaw et al.1989).

2.2.4.1.2. CLOSE INTERACTION WITH CUSTOMERS

Empirical evidence suggests that the understanding of user needs is essential to the development of commercially successful new products (Maidique and Zirger 1984, Rothwell 1977, Cooper 1979a). The main argument in favor of this, is that by understanding user needs, suppliers develop products more compatible to user needs and expectations. This in turn has positive effects on the adoption response of potential adoptors. Several approaches have been introduced in the literature through which the supplier can understand better the user needs. These methods share a common base which is the interaction of the supplier with its customers during the new product development process. In proportion to the customer's involvement, these approaches range from a simple mode of interaction, mediated by market/marketing research efforts which are initiated by the supplier, to the actual cooperation of the supplier with the customer on different stages of the NPD process or throughout this process. As mentioned in Section 2.1., Parkinson (1984) attributed the success of German companies to their heavy interaction with customers throughout the new product development process. Furthermore he found that British companies did not interact with their customers mainly due to their belief that customers are incapable of providing any substantial help in the new product development process.

The decisive role of customers in the new product development process has been postulated by many researchers and have been substantiated by Hippel (1977a, 1977b, 1978) and Foxall (1984, 1988, 1989). Hippel (1986) introduced the concept of "lead users" as "...users whose present strong needs will become general in a market place months or years in the future" (p.791). He suggested that these users can be identified by the supplier and they can serve for the diagnosis of new product opportunities, as sources of design data, for the testing of new product prototypes, as first adopters of the innovation and as opinion leaders for later adopters. Thus the product produced through such an interaction is expected to be more compatible with the needs of the customers, which in turn will speed its adoption and diffusion. In addition the better understanding of the technology gained by the customers through their participation in the development process secures the very early adoption of the innovation by them. This might also take place if the participating customers have devoted any resources in the development process in the form of financing or sponsoring it, or due to any incentives such as price reductions, provided by the supplier as an appreciation of their help e.g. in prototype testing. This early first adoption will speed the rate of diffusion (Baker 1983).

The discussion above has illustrated the role of the supplier-customer interaction in the NPD process upon the adoption and diffusion of the innovation. It must be noticed that this interaction and its latitude is clearly a managerial decision of the supplier, in spite the fact that sometimes the incentive for such an interaction lies with the customer. A similar concept to supplier-customer interaction is the vertical co-ordination proposed by Robertson and Gatignon (1986). Their main explanation to the above is that it increases the flow of information and that "firms that are strongly linked to suppliers are more likely to serve as beta sites for new technology and to receive preferential advance information and delivery dates" (Gatignon & Robertson 1989, p.38). Empirical evidence in favor of this proposition is provided by Gatignon & Robertson (1989) and Bamossy & Eenennaam (1989).

2.2.4.1.3. CLOSE INTERACTION WITH UNIVERSITIES AND/OR RESEARCH INSTITUTIONS

Empirical evidence has demonstrated that firms with outstanding records of commercially successful new products were heavily involved with Universities and other research institutions during the development process of their products (Parkinson 1984). Their assistance in the commercial success of new products is evident in two ways. Firstly, they assist by providing technical information and advice. This facilitates the supplier to make use and take advantage of technologies and technical knowledge which are outside its own firm's capabilities . In this way they affect the adoption response of firms by contributing in the development of a technologically advanced product. Secondly, due to their scientific reputation serve as opinion leaders (Rogers 1983). Thus innovations developed through their involvement share the same reputation among potential customers. This in turn reduces the perceived risk of the potential adoptors and as such, triggers a positive adoption response.

Although in the above discussion only universities and research institutions have been taken into account, in a broader sense, one can argue about the role in adoption/diffusion of a spectrum of third parties with which the supplier can develop interactive relationships (Biemans, 1989).

2.2.5. ACTIVITIES IN THE ADOPTION & DIFFUSION PROCESS

The period of the adoption and diffusion of an innovation is perceived as being dominated by the marketing actions of the supplier. Despite such indications and from different research fields, the role of marketing actions in the adoption and diffusion of innovations have not yet been explicitly taken into account. This lack of empirical research is attributed by Simon and Sebastian (1987) to the difficulty faced by researchers to obtain data on both sales and marketing variables. According to them, the diffusion process often covers a large number of years and during that period the innovation is subjected to radical technical changes. Thus data are difficult to be obtained and sometimes they are meaningless. However, many individual attempts have investigated the role of marketing mix variables in the diffusion of innovations and the role of marketing in both the commercial success of new products and technically progressive firms. A prominent step in advancing what is known about this issue is to report and integrate these individual attempts.

2.2.5.1. STRATEGIC ACTIVITIES

An eminent strategic issue for the supplier of a technological innovation is the choice of the mode for the exploitation of the innovation. The option most frequently addressed in the marketing literature involves independent development manufacture and commercialization by the firm. However, recent developments in the management and marketing of technology suggest that the supplier has many alternatives in exploiting his firm's technology. Similarly the buyer of technology can use different methods for acquiring it. To this end, a large number of exploitation and acquisition methods have been identified in the literature: licensing, franchising, contracting out functions, company ownership shifts, mergers, joint ventures or alliances, reciprocal technology exchange agreements, educational acquisitions (Ford and Ryan 1981, Capon and Glazer 1987, Ford 1988, Clarke et al.1988, Roberts 1982, Linn 1981, Hlavacek et al.1977, Easingwood and Beard 1989, Roberts and Berry 1985).

This stream of research has concentrated on the reasons for using alternative methods for technology exploitation & acquisition, the benefits to be gained and the problems inherent for the supplier or the buyer. Yet, the linkage between method of exploitation and speed of adoption and diffusion has not been acknowledged explicitly. However these very reasons for using the above methods incorporate their impact on the adoption response of firms.

Ford and Ryan (1981), maintain that geographically selective license agreements can furnish additional revenues for the supplier based on wider application of the technology, diffusion in broad terms. Again, active sale of licenses ensures the use of technology by many companies which eventually leads to standardization and advances the speed of diffusion.

Noteworthy, Clarke, Ford and Saren (1988), found that the initiative for using an exploitation-acquisition method lies with the buyers and that there exist high levels of variety in acquisition and exploitation methods in specific industries. This finding is important in two ways. Firstly it calls for a more active role on the part of suppliers and secondly it provides a promising area for segmentation research based on the methods of acquisition favored by industries or firms. Since buyers favor the acquisition methods that correspond better to their present and anticipated needs and objectives, ability of the supplier to respond accordingly is expected to facilitate adoption and thus, to elicit a positive adoption response from the part of potential adoptors.

2.2.5.2. TACTICAL MARKETING ACTIVITIES

As it was shown previously, studies on the success and failure of innovations have provided many insights in the role of marketing with regard to adoption/diffusion of innovations. Another field of research that can provide equally useful insights, is that of new product diffusion models.

Diffusion models have been developed mainly for sales forecasting purposes (Simon and Sebastian 1987, Sultan et al. 1990). However Mahajan et. al (1990) provide many examples were such models have been used for descriptive and normative purposes. Therefore they are capable for testing hypotheses and for providing guidelines for the marketing of a new product. Early attempts in marketing diffusion modelling have excluded the influential role of marketing strategies and marketing mix variables. However, during the 70's and 80's diffusion models were introduced which considered explicitly the role of marketing mix variables such as price, promotion & advertising, personal selling, distribution and timing of new product introduction. To this end, Simon & Sebastian (1987) and Kalish (1985) found that advertising, promotions and sales efforts apart from their effect on generating awareness, increase the likelihood of adoption since they reduce the search cost and other costs on the customer's side. It is important to note that consideration of advertising's effects on the diffusion of industrial innovations is consistent with empirical findings which state that non-personal mass communication tools are usually more efficient and even more effective than personal selling at the early stages of the communications hierarchy (Traynor and Traynor 1989, Patti 1979). This verifies again, that the supplier can influence the adoption and diffusion process by employing the most appropriate communication tools and investing on promotions and sales efforts. Furthermore, normative uses of diffusion models suggest that heavy advertising must be employed even before the product is introduced and a withdrawal of the product after the end of the cumulative effect of advertising (Mahajan et al. 1984).

Regarding price Kalish (1985) maintain that customers adopt an innovation if its perceived value is greater than its selling price. Furthermore at the early stages of the innovation's introduction where uncertainties of the product's performance exist, its value is lower than if experience information was available. As more customers adopt the innovation experience information become available which in turn increase the perceived value of the innovations. He sustains that "rate of adoption is determined by awareness diffusion, which is controlled by advertising, and the rate of growth of the potential adopter population which is controlled by price" (p.1569).

In general, marketing expenditures in advertising, personal selling and other forms of communication have been postulated by Robertson and Gatignon (1986) as important influences on the speed and pattern of diffusion. Furthermore, suppliers' marketing can influence adoption by providing different forms of promotional incentives to the adoptor thus, encouraging his decision to adopt the innovation. In a study of the adoption of laptop computers for the sales force of industrial firms, Gatignon and Robertson (1989) found that supplier incentives were positively related to adoption. Again marketing actions through segmentation can determine the adopter categories of an innovations. Such conclusions have also been reported by marketing modelers. Mahajan et. al (1990) maintain that diffusion patterns of certain products such as prescription drugs can be influenced by controlling their supply and distribution. Wind et. al (1982) suggest that since diffusion patterns differ by market segment, the suppliers can improve the marketing of their innovations by planning and forecasting on a segment by segment basis. Accordingly they can achieve a more rapid adoption of their innovations by targeting first the most receptive market segments. Similarly in a study of high technology launch strategies in the U.K., Easingwood and Beard (1989) found that among the most frequently cited strategies were the approach of innovative adopters, the use of educational programmes and the attempt to create a "winning" reputation. Again reputation of the supplier has been postulated by Robertson and Gatignon (1986) as a factor that influences diffusion, and as a risk reduction mechanism in organizational buying behavior (Kassicieh and Rogers 1986, Hawes and Barnhouse 1987, Mitchel 1990, Cardozo and Cagley 1971). In addition Rogers (1983) found reputation to be of great importance since "the innovations are often judged in part on the basis of how the change agent is perceived" (p.316) by the buyer.

The above empirical evidence has demonstrated that the supplier of an innovation by means of marketing tools can influence the adoption response of firms. In addition the ways in which different marketing tools influence adoption and diffusion have been highlighted. Since there exist a large number of marketing tools that the supplier can use, effective use of them can only be assumed if the supplier possesses a certain degree of proficiency in their management. However developments in organizational buying behavior suggest that the different conditions and the objectives of buyers influence the effectiveness of each marketing tool used by the supplier. Therefore in addition to proficiency the supplier must be capable of adjusting or adapting his marketing mix according to the condition prevailing in the market in general or in the firm of a potential adoptor specifically.

2.2.6. CONCLUSIONS & IMPLICATIONS FOR PRESENT STUDY

This chapter has attempted to elucidate the ways in which the suppliers of innovations can influence the adoption response of firms towards their innovations in the market place. Past empirical evidence from a variety of salient fields of inquiry has highlighted the following aspects:-

The supply side factors which affect adoption of an innovation can be sought in two levels. First, at the level of firms' behaviour in the industry and secondly at the level of firms behaviour during the continuous development-adoption and diffusion process of their innovations. The first level includes the conduct of firms which is mediated by the structural properties and other conditions inherent in the industry. The second level is distinguished into a) pre-launch activities, where research and development efforts dominate, and b) activities during adoption and diffusion, where efforts to market the innovation are dominant. However it must be pointed out that this distinction has been made for reasons of better understanding and it is not a real one since (and in particular for industrial products) marketing activities are evident both before and during the development process and further developmental activities occur during the adoption or diffusion process.

In the foregoing discussion the role of suppliers is perceived both as proactive and reactive. Proactive in the sense that suppliers by scanning their markets can receive messages, anticipate or identify needs or technological opportunities and translate them into feasible innovations. Moreover by applying effective marketing tools they can increase their customers' receptivity to innovations. Reactive in the sense that suppliers who realise differences among individual adoptors can adjust their offerings accordingly. Such adjustments may involve both technical changes (modifications of the product) and marketing changes (modifications of policies and selling practices) so as to satisfy both their objectives and their customers' needs.

The emphasis here on suppliers activities does not undermine the role of buyers. Instead, as it is apparent from the evidence presented above, the continuous development-adoption and diffusion process of innovations is formulated 'heuristically' through the continuous proactive and reactive interplay among suppliers and buyers.

Moreover, the foregoing discussion indicates implicitly that the performance of an innovation in the market place (its adoption & diffusion rates) depends largely on the excellence or proficiency of suppliers during the continuous development-adoption and diffusion process. Indeed the empirical evidence presented above has documented well a number of actions suppliers can undertake to assist their innovations performance. This in turn, might imply that these actions are optional. However, little is known about the influence upon the adoption response from the lack of use of these actions by the suppliers or from the use of other inappropriate activities. Obviously the latter necessitates more exploratory research within the reasons related to the suppliers that contributed to the adoption or rejection of an innovation by a potential adoptor. Some evidence has been provided for this by Gatignon and Robertson (1989) who found that adopters of personal computers have received supplier incentives (discounts) while the non-adopters have not. However, such quantitative findings, although very useful, do not indicate the importance of this action in the decision of potential adoptors to adopt or not the innovation.

Therefore, explicit consideration of the developmental efforts and marketing tools employed by the suppliers, and assessment of their relative importance in the adoption decision, is expected to highlight the way in which the adoption response of firms is influenced by supply side factors.

For a researcher, in order to ground the issues above, is necessary to have a good knowledge of the suppliers' development and marketing activities with regard to an innovation as well as, a clear understanding of the reasons that led potential adopting firms to either adopt or reject this innovation. In order to cope with this need, the present research was planned so as to inquire in depth a) the developmental and marketing activities of the suppliers of specific innovations and b) the reasons for adoption or rejection of these innovations by potential adoptors.[10]

Having explained the influence upon adoption of supply side factors, the next chapter will investigate the impact upon the adoption response of firms of the characteristics of the innovations and their perceived risk.

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[10] See Chapter 7, Sections 1 & 2 for the relevant discussion.

CHAPTER THREE

ADOPTION OF INNOVATIONS AND THEIR CHARACTERISTICS

3.1. INTRODUCTION

Before turning to examining the various characteristics of innovation, it is of great importance to make a distinction between 'actual' and 'perceived' attributes. Although the concept of perception exists to both of the above categories, 'actual' indicate the characteristics of innovations as they are 'perceived' by experts in the particular field of the innovation or by the innovating (producing) unit (Rogers 1983). Consequently 'perceived' characteristics are those held by the potential adoptors of the innovation, indicating their personal subjective perception regarding the innovation. It should be stressed that in the innovation literature it is the perceived attributes of an innovation by the potential adoptors which is the most important dimension in relation to the rate of adoption (Robertson & Gatignon 1986). Notably, Rogers (1983) postulated that "like beauty, innovations exist only in the eye of the beholder. And it is the beholder's perceptions that influence the beholder's behaviour" (p.212).

Research on innovation attributes has been pursued both in the adoption and diffusion of innovation research tradition, as well as in organizational buying behaviour.

Organizational buying behaviour as a research tradition can be regarded as a sister to that of the adoption of innovations. While the similarities are obvious their major difference is that research in the former possesses a more general scope than that of the latter which focuses specifically on innovations. In addition, studies on adoption of innovations have tended to be dominated by researchers with a rational and economic orientation in explaining the outcome of the adoption process while organizational behavioural studies are dominated by behavioural scientists who focus on the buying process per se (Baker 1975a). Within the organizational buying behaviour research, some of the attributes of innovations have been appreciated and researched to a higher and a more advanced level than in adoption and diffusion studies.

The author believes that there exists a high degree of overlap and congruence between the concepts of innovation attributes studied in the adoption of an innovation and those studied within the general literature on organizational buying behaviour.

Therefore, this chapter attempts to bring together the findings from the above two strands of research. This attempt, although it is difficult due to the large amount of studies, is most promising for guiding the study of innovation attributes in this study and in the future.

3.2. INNOVATIONS ATTRIBUTES FROM AN ADOPTION AND DIFFUSION PERSPECTIVE

To begin with, Rogers (1983) proposed five innovation attributes which according to him are mutually exclusive and as universally relevant as possible. These five attributes have as follows.

3.2.1. *Relative advantage* is the degree to which an innovation is perceived as being better than the idea it supersedes, (Rogers and Shoemaker 1971). Relative advantage may be expressed in terms of economic profitability (Mansfield 1968b), but also in other ways. Gold et al.(1970) concluded that "the innovations which survive and achieve eventually wide diffusion are those whose utilization has been associated with profitability" (p.233). However Baker (1975a) argued that "...use of the term relative advantage in the sense of economic benefit...is misleading" and elsewhere "...in the absence of an agreed on definition, it (relative advantage) has generated into a meaningless catchall under which may be subsumed...every factor..." (p.69).

Similarly Tornatzky and Klein (1982) have stated that "relative advantage is too broad and amorphous...is the garbage pail characteristic in innovation studies into which any number of innovation characteristics is dumped...thus relative advantage studies lack conceptual strength, reliability, and prescriptive power" (p.34). This perhaps can explain the remarkable congruence among a large number of studies where relative advantage has always been found positively related to the adoption of innovations.

From another point of view, Lancaster & Taylor (1986) state that there might be situations where an innovation does not directly supersede anything because it is totally new. They argue that in this case relative advantage would presumably, relate to the utility of using the innovation versus its non-use.

3.2.2. *Compatibility*, which according to Rogers and Shoemaker (1971), indicates the degree to which an innovation is perceived as being consistent with values, past experiences and needs of potential adopters. In the industrial framework it covers also the consistency of the innovation with previously introduced ideas, practices and other innovations. Tornazky and Klein (1982) state that the first of the above interpretations of compatibility represents a kind of "normative or cognitive compatibility" (compatibility with what people feel or think about a technology), while the second suggests a more "practical or operational compatibility" (compatibility with what people do) (p.33).

The hypothesised and identified relationship is that the more compatible an innovation is, the higher the degree of its adoption and the faster its diffusion.

3.2.3. *Complexity*. According to Rogers and Shoemaker (1971), complexity is the degree to which an innovation is perceived as relatively difficult to understand and use.

Generally, complexity is regarded as negatively related to the adoption and diffusion of innovations. Support is provided by Tornazky and Klein (1982) who found that six out of seven studies they reviewed were reporting a negative relationship between complexity and adoption of the innovation.

3.2.4. *Trialability or Divisibility*. Trialability is the degree to which an innovation may be experimented with on a limited basis (Rogers & Shoemaker 1971), and divisibility is the extent to which an innovation can be tried on a small scale prior to adoption (Fliegel & Kivlin 1968). Both terms are closely related, although not identical (Tornazky & Klein 1982), but the term trialability is more widely used since it includes the notion of the "psychological trial" (Rogers & Shoemaker 1971). Generally, it is assumed that a high degree of trialability is positively related to the adoption and diffusion of innovations. However, Tornazky and Klein (1982), in their review of the literature, did not find any consistent results regarding the effects of this attribute.

3.2.5. *Observability or Communicability* It is the degree to which the results of an innovation are visible to others. Generally, the more visible the results of an innovation the more likely it is that the innovation will be quickly adopted and diffused. Again Tornazky and Klein (1982) were unable to deduce any statistical significant conclusions regarding this attribute from the relevant studies they reviewed.

Ostlund (1972) used the innovation attributes suggested by Rogers & Shoemaker along with perceived risk and found them capable of distinguishing better between buyers and non-buyers of consumer products than predispositional and socioeconomic/demographic variables.

However, Allen & Wolf (1978) found in the educational sector that only complexity of the innovations was significantly related in a negative way with the adoption of innovations by educators. Although they admitted that the possible inappropriateness of their data might have caused this result, they argued that since Rogers' generalized attributes have been established from studies on individuals behaviour they might not be appropriate within a collective decision making system.

Fliegel and Kivlin (1966,1967,1968) extended the list of attributes developed by Rogers. In their studies on a large sample of Pennsylvania's large and small-scale farmers, they found that the magnitude of the effects of the perceived attributes of the innovations were different when being considered alone as opposed to their simultaneous effects[11]. In addition, high intercorrelations between the different attributes indicated that attributes are part of a complex.

In the industrial setting of outstanding importance is the work of Hayward (1975) and Hayward, Allen and Masterson (1976,1977). The innovations common characteristics studied by them were the following: Initial cost, Running cost, Pay-off period, Savings in time, Reduction in pollution, Reduction in dust, Reduction in noise, Mechanical advantage, Flexibility, Trial on a small case, Reliability in operation, Ease of understanding. Among their major findings was the fact that based on the characteristics of innovations one is able to

[11] Specifically the application of fourteenth-order partial correlations as compared to zero-order correlations between attributes of innovations and rate of adoption yielded, in many cases, different results on the magnitude of each attribute and sometimes in different directions of the attribute's magnitude on the rate of adoption.

construct "profiles" or "clockfaces" for each innovation which in turn can be used as valuable tools for the engineering and the marketing of the innovations in question.

In another study Hayward & Masterson (1987) included in their sample of industries and innovations, an innovation from the baking industry, the Chorleywood bread process. In this article two points are of extreme importance: Firstly, regarding the innovation in the baking industry, three new attributes of great importance emerged, i.e. ease of interfacing, ease of maintenance and degree of prestige. It is important to note that the degree of prestige is not a physical characteristic of the innovation but rather it represents a pure psychological effect of its use which in turn can be regarded as an intangible attribute. Secondly, although the innovation in the baking industry was a non-traditional one, its pattern of diffusion was similar to that of the traditional innovations. This happened mainly due to the marketing activities of the manufacturer of the innovation who demonstrated the innovation to a large number of individual bakers, and therefore, they stated the question whether or not the methods being used to introduce the innovation are those most likely to achieve rapid adoption. The paramount importance of the full exploitation of the demonstrability of an innovation has been advocated by Ettlie and Velenga (1979). Similarly, Wilton and Pessemier (1981) reported that perceptions change as learning progresses. Thus the way in which a sponsor communicates an innovative product or service can influence perceptions, preferences and choice.

Baker and Parkinson (1976) concluded that the innovation attribute of 'essentiality' is very important to adoption and diffusion. Essentiality relates to the importance of an innovation to the continued operation of a company and might evolve due to different reasons such as the need of a company to maintain its competitive position relative to the industry, or the need of a company to apply new governmental regulations or restrictions.

Finally, Ozanne & Churchil (1971) included in their 5 dimensions process of industrial adoption a dimension which they called purchase-directing factors. Of the five classes of purchase directing factors that emerged from their study, two were the cost/benefit comparisons and the special product attributes while the remaining three were quick delivery, past experience with the supplier and personal selling. Clearly the latter three classes represent not technical attributes but rather intangibles which spring from the supplier. The same authors reported that, although statistically not significant, firms with more technical and scientific policy makers tended to base their decisions on economic considerations. In addition, decision groups with high level personnel displayed a tendency of being influenced by previous experience with the supplier.

3.3. CRITICISM AND RELATED ARGUMENTS

In the adoption and diffusion literature the approach used to investigate the innovations attributes has been oriented towards the perceptions of the potential adopters. Typically, firms which have or not already adopted the innovations are asked to comment on the attributes of the innovations in question, usually by using a Likert type scale. Then, simple statistical measures are used (frequencies or correlations) in order to find either a) which characteristics are the most important for the adopting units or, b) which attributes were perceived differently between adopters and non-adoptors.

Although the above procedures have produced a number of valuable insights into the effects of the attributes of innovations in their subsequent adoption and diffusion, there are some major disadvantages which need to be highlighted.

Firstly, it has been argued that after a potential adopting unit becomes an adopter, its comments on the attributes of innovations suffer from a post-hoc rationalization which can severely disturb the identification of the attributes as they were perceived before the adoption (Robertson & Gatignon 1986).

Secondly, innovation is a very complex item consisting of not one but several attributes. Studies on innovations do not indicate how those attributes link together in the perceptions of the adopters (Zaltman & Linn 1971)

Thirdly, the majority of those studies did not take into account the individual, organizational, social and environmental contextual conditions in which these perceptions are formulated and indeed change. Furthermore, it is widely accepted that these perceptions are, at least partially, situationally determined and it can be assumed that perception of attributes of an innovation will vary between different groups of adoptors and as their situations change

(Lancaster & Taylor 1986). Downs and Mohr (1976) postulated that innovation attributes interact with other organizational characteristics in a way that an innovation might be seen as minor or routine by some organizations but as major or radical by others. The same authors stated that the innovation attributes used for the construction of a typology of innovations are not primary attributes but secondary ones. The latter may vary from organization to organization thus prohibiting the existence of a consistent typology of innovations upon their secondary attributes. Despite their severe criticism Downs and Mohr suggested that "one way of coming to grips with secondary attributes is to think of them not as being composed wholly of characteristics of the innovation or the organization but as characterizing the relationship between the two" (p.706).

Despite the above extensive and constructive criticism, the author deems that the following issues will illuminate some more critical inadequacies of the research on innovation attributes.

Firstly, attribute perceptions are of great utility to the marketer since they provide insight into what the buyers view as positive or negative about a given product. In addition it is argued that perceptions can direct (influence) behaviour (Ostlund 1972). Thus, it is of imperative importance for the marketer to know the potential buyers' perceptions both at the development stage of the product and at the commercialization stage so as to be able not only to dress the product with the specific features required but also to formulate the advertising and other promotional messages of it. Nevertheless, what carries more importance for the marketer is the knowledge of the way in which those perceptions are formulated in the minds of the potential adopters as well as of the conditions and mechanisms capable of changing or guiding them towards a certain format. Research findings on innovation attributes do not provide any hints of how these perception are formulated. In a similar manner Tornazky and Klein (1982) commenting on the attribute of complexity stated that like many other innovation attributes, it lacks a certain specificity due to the fact that a) we do not know what makes an innovation to be perceived as complex or b) what makes people to perceive it as complex.

Secondly, since the adoption decision process is a stage process, one knows little about whether different attributes are regarded more important at each stage or whether their magnitude, although always present, changes at different stages.

Third, it is clear from the above literature review that past research on the adoption and diffusion of innovations has focused mainly upon technical and economic attributes of innovations. The lack of interest on the intangible attributes of innovations is very surprising since it is well known that each product is a system of tangible and intangible attributes (Kotler 1988).

Levitt (1981) postulated that every new product has a degree of intangibility because unless the customer is in a position to fully test it before buying it, the only thing he gets is promises of future satisfaction. According to the same author, the careful handling of intangible attributes creates a risk reduction mechanism which inevitably contributes to the adoption of the product irrespective of whether the product is consumer or industrial in nature.

It is believed that, this lack of attention to the effects of the intangible attributes of industrial innovations on their adoption and diffusion can be explained by the following reasons: 1). Rationality of the decision making in the industrial purchasing-especially in purchasing new high technology products - favors the dissemination of information relevant to the technical/tangible attributes of the innovation. 2). Owning to the critical role of the scientific and technical personnel in the purchase decision of new technology, research was focused on satisfying their information needs which were found to be of scientific and technical origin (Chakrabarti et al. 1982).

Finally, it is recognised that the ultimate value of the adoption and diffusion of innovations research findings lies on the fact that they can be used by the producers of innovations and other policy makers in order to achieve a more rapid adoption and diffusion. In that respect the findings from the research on innovation attributes are not only confusing but also dangerous. For example unconditional recognition of the negative effect of innovation complexity upon the adoption and diffusion of innovations might lead firms to avoid producing complex innovations and policy makers to avoid promoting them, in spite of the fact that sometimes the most valuable radical innovations are also the most complex.

3.4. INNOVATION ATTRIBUTES FROM AN ORGANIZATIONAL BUYING BEHAVIOUR PERSPECTIVE

Research in organizational buying behaviour concentrates on the buying behaviour of firms as it is depicted in the behaviour of the persons participating in the buying center or decision making unit (DMU) during the buying process. On the other hand, the adoption process in innovation studies, with some exceptions, has been referred to as a company event without any qualification.

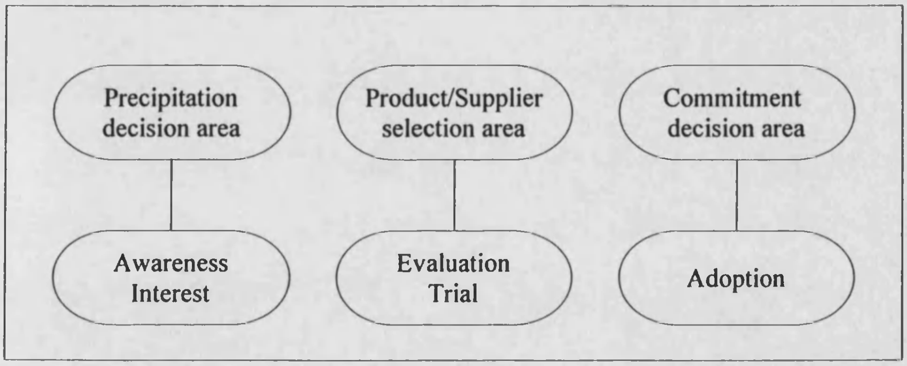
Major research findings in organizational buying behaviour have established well, among other, the concepts of different phases or stages in the organizational buying process, the classification of different buying situations, the buying determinants, the existence of the buying center, and the different roles of the participants in the buying center (Webster 1965, Robinson et al. 1967, Webster & Wind 1972).

Furthermore different authors have tried to integrate the various models of organizational buying behaviour while others realizing the similarities between organizational buying behaviour and adoption of industrial innovations have attempted to produce a synthesis of the most popular adoption model, the one developed by Ozanne & Churchill (1971), with buying behaviour models.

In the first category Sheth (1973) developed an integrated model of organizational buying behaviour, which although complex, is comprehensive in the sense that it incorporates the majority of the developments in the field and introduces some new aspects. Characteristics of products and suppliers constitute a major part of this model. According to Sheth, attributes of products and suppliers, as perceived by buyers, constitute the criteria on which buyers formulate their expectations regarding the perceived potential of products and suppliers to satisfy their objectives in any buying situation. Furthermore, Sheth makes a distinction between explicit and implicit criteria. The former include product quality, delivery time, quantity of supply, after sales service and price, while the latter incorporate reputation, size, location, reciprocity relationship with the supplier, personality and technical expertise, salesmanship and even life style of the sales representative. Sheth acknowledges that implicit criteria become more and more important and he provides a number of factors which account for the differences in buyers' perceptions regarding the above criteria. In addition, according to Sheth, product-specific factors (time pressure, perceived risk and type of purchase) along with company-specific factors are major determinants of whether the buying decision is taken jointly or autonomously.

In the second category Moriarty and Galper (1978) realized that the buying behaviour models represent an internal purchasing perspective of the buying process while the model by Ozanne and Churchill (1971) gives an external (marketing) viewpoint. Thus, they were able to build their own buying process model by integrating both the above perspectives. Hill and Hillier (1977) tried to link the major decision areas of the organizational buying process with the stages of the Ozanne and Churchill's model. This matching of the two concepts is represented in the following table 3.1.

Table 3.1 Linkages between major decision areas in the organizational



Source:Hill and Hillier, 1977, p.133

Two points of interest arise from this table: 1. The product and supplier decision areas are presented together and are linked with the evaluation and trial stages. According to Hill and Hillier products - especially innovative ones - are supplier specific and thus, the selection of a product means the selection of a supplier automatically. In terms of the present discussion the above means that organizational buying researchers have appreciated the importance of intangible product attributes (at least those relevant to their supplier.) 2. The linkage of the product/supplier selection area with only the evaluation and trial stage gives the impression that product and supplier characteristics do not have any effect on the awareness and interest stage or on the adoption stage of the product. Confirmation of a counter argument comes from the study of Rabino (1983) who examined the importance of several innovation attributes as they relate to concept evaluation of a new imaging system bought by art and production directors of large advertising companies.

3.5. TANGIBLE & INTANGIBLE PRODUCT ATTRIBUTES AND BUYING BEHAVIOUR

Shaw et al. (1989) in their investigation of the decision criteria used by MIS directors while choosing a mainframe operating system, examined along with the physical/tangible attributes, a number of intangible/ psychological attributes of the products and/or the suppliers. They concluded that the vendor-related attributes were more important for buyers than the product performance attributes. In addition they found that the vendor-related attributes were related to uncertainty over future product development and migration path. In that respect intangible attributes play the role of risk reducing mechanisms for the buyer. Indeed, the major concern of the buyers was the ability to catch up with the possible future upgrading of the system as well as the development of complementary products. This situation is particular relevant to new industrial technologies where the decision to adopt and implement them carries the risk of locking the firm into a certain technological path from which is very difficult to shift if required. The same authors found that, in the case of the purchasing of mainframe operating systems, buyers seem to follow a hierarchical buying process. First, they examine the functional characteristics of the product and after they detect its' required technical qualification they proceed to examine the intangible attributes of it. Finally the adoption decision is taken only if they find that the intangible attributes meet their present and future needs and requirements.

Kassicieh and Rogers (1986) examined the criteria used by different firms whilst buying a microcomputer. By studying 129 firms which were classified in three groups (production group, retailers and wholesalers group, services group) they classified the above criteria in 5 categories. They found that the importance of each category of criteria is different according to the organizational size and the computer literacy of the firms within each group. Moreover their importance is different according to the group where the firm belongs and the orientation of each group. These categories of criteria are:

1.Service and sales support characteristics
2.Product quality characteristics
3.Product performance characteristics
4.Use/Cost characteristics
5.Brand and Manufacturer reputation

Lehmann and O'Shaugnessy (1982) developed their own classification scheme of the criteria used by purchasing managers in buying different categories of products and they found that economic criteria are the most important in the case of standard products with simple make-up and standard applications. Performance and legalistic criteria dominate in the case of non-standard products with complex make-up and novel application, while integrative and adaptive criteria, although present in every category of products, presented the least variation among them.

Abratt (1986) studied the buying behaviour of 54 firms in the market of high technology instrumentation. He found that, among the criteria used for supplier and product choice by those firms, the most important was the technical service provided, perceived product reliability and after sales support. Product price was rated of very low importance and this was an indication of the willingness of the firms to pay a price premium for a highly reliable product accompanied with technical and after sales support.

Finally, Dempsey (1978) examined the relative importance of 21 vendor attributes in capital equipment new task and component material modified rebuy purchasing situation in the electric utilities and electronic manufacturers industries. He concluded that irrespective of the relative importance of each category of attributes all of them were essential in the selection of a vendor. Thus attributes of lower importance might be essential when they do not meet the customers needs and requirements. This is relevant with the argument that satisfaction of a required attribute might not guarantee too much when this attribute is of lower importance, but inability to meet the requirements of the buyer on such an attribute (of low importance), might be of great importance in the customers final choice.

It is clear from the above discussion that within the buying behaviour research tradition both tangible and intangible product and supplier attributes have been taken into account in the decision process of a prospective buyer. In addition some attempts have been made towards the identification of the factors that determine the importance of different attributes and of the way these attributes affect the buying behaviour. *However, the above attempts are concentrated around the problem of supplier selection which gives the impression that the buying firm is already committed to the product or technology and the decision to adopt it has been taken in advance.* Thus, with minor exceptions, the fact that a firm might avoid to adopt a technically superior product because of its supplier's insufficient qualifications regarding other aspects such as delivery, after sales service and support, seems to be depreciated. A more rigorous and complete approach that overcomes some of the above deficiencies is the research approach dealing with perceived risk.

3.6. PERCEIVED RISK AND BUYING BEHAVIOUR

The concept of perceived risk is credited to Bauer who three decades ago argued that consumer behaviour involves risk in the sense that any action of a consumer will produce consequences which cannot anticipate with anything approximating certainty, and some of which at least are likely to be unpleasant. On the same lines Hawes and Barnhouse (1987) argued that "risk is present in any buying situation where there is a choice among alternative market offerings and uncertainty about the consequences of any given selection" (p.287).

Peters and Venkatesen (1973) found that perceived risk was negatively related to the adoption of a new model small computer. Personal interviews with adopters and non-adopters of that product indicated that high perceived risk was resulted from uncertainty with regard to such possible consequences as being oversold, lack of use, poor service and support and assimilation into given operations. Uncertainty and consequences were the major issues in perceived risk as it has been conseptualized by Cox (1967).

Regarding different types of risk Choffray and Johnston (1979) distinguished risk at the organizational level and risk at the individual level. In the same respect Newall (1977) suggested that there are two types of perceived risk. The company risk, which is related to the potential impact of a particular purchase on the company's well-being, and personal risk which is related to the consequences of a false decision for the individual's standing in the firm. Valla (1982) developed the following types of risk: technical, financial, delivery, service, and customer/supplier interaction.

From a consumer point of view Bettman (1973) identified as inherent risk the risk that a product class holds for the consumer and handled risk, the amount of conflict a product or product class causes when the purchaser chooses a brand in a particular buying. In other words handled risk is the inherent risk modified by information. Hawes and Barnhouse (1987) attempted to measure the personal perceived risk of purchasing executives by asking 143 purchasing executives to indicate the certainty and seriousness of a series of potential personal consequences if the chosen supplier failed to perform the required tasks satisfactorily.

From a purchasing point of view Hakanson and Wootz (1975) hypothesized that purchasing behaviour is a function of perceived risk which in turn is a function of three components which represent the characteristics of the buying situation, the characteristics of the decision maker and the characteristics of the decision environment in the firm.

From the research findings reported above, it became clear that there are different types of perceived risk and that the degree of risk perceived among buyers is affected by a large number of factors. In the remaining discussion the different risk reduction mechanisms and the different practical implications suggested for both buyers and suppliers in dealing with perceived risk will be presented.

To begin with Roselius (1971) stated, from a consumer point of view, that when a buyer perceives risk in a buying situation he will pursue the following strategies of risk resolution: 1. He could reduce perceived risk by either decreasing the probability that the purchase will fail or by reducing the severity of real or imagined loss suffered if the purchase does fail. 2.

He could shift from one type of perceived loss to one for which he has more tolerance 3. He could postpone the purchase in which case he would shift from one general type of risk to another. 4. He could make the purchase and absorb the unresolved risk. Two points in the above statement are of great importance. First, the fact that in any case the buyer has to bear a certain type and amount of perceived risk. Secondly, the type and amount of risk to be coped with by the buyer depends on his ability to tolerate certain types and amounts of perceived risk and the availability of certain risk reducing techniques. Regarding risk reducing techniques the following table 4.2 presents a large number of such techniques as they have been identified in past research.

Similarly, regarding perceived risk, the industrial marketer is faced with a dilemma. He can either try to decrease the buyer's perceived risk or stress it. Both actions indeed might change the conditions of the game by placing the firm in another category of choice. Bettman (1973) suggested that when an industrial marketer wishes to reduce risk he can do so by either influencing the buyer's decision rule or his importance for the product class. When risk is high he can do that by emphasizing that his brand is in the acceptable set and by providing further information for reducing the handled risk. Generally, in high risk situations the ranking is quality-service-price and buyers are willing to pay a premium price above average when quality and service requirements are met (Cardozo & Cagley 1971). In addition a sequential evaluation instead of an array and review evaluation appears to be made when risk is high, product specifications are not precise and buyers need to know more for additional offerings. In this case the industrial marketer should try to be the first to be contacted and to meet the product specifications (Cardozo & Cagley 1971). But when the buying is of low risk, price becomes more important. Thus a marketer with a high priced product should stress the riskiness of the product class by stressing importance while at the same time stressing the quality of his own product.

Table 4.2 : Risk Reducing Techniques

Using source loyalty (1,2,3)
Deliberating (1)
Choosing a leading company in the field (1,4,5)
Questioning suppliers' customers concerning their experience with the supplier's performance (5,6,1)
Using approved supplier lists (7,1)
Using brochures, magazines etc. (8,9,1)
Having a highly structured purchasing procedure (10)
Group decision making (10)
Considering more suppliers (4,10,11,12)
Multiple sourcing/split procurements to backup source of supply (2,5)
Using quantitative techniques (13)
Ensuring performance guarantees (2)
Using penalty clauses (5)
Obtaining the opinion of a majority of co-workers that supplier is satisfactory (5)
Confirming with members of upper management (5)
Visiting supplier operations to observe its viability firsthand (5)
Communicating with your supplier (14)
Being certain about buying goals (1)
Hiring a consultant (1)
Using trade shows exhibition etc. (1)
Taking legal advice (1)
Seeing demonstrations (1)
Preferring a close geographical location (1)
Using industry norms/other similar businesses (1)

Where 1: Mitchell 1990, 2: Puto et al.1985, 3: Bettman 1973, 4: Cardozo et al.1971, 5: Hawes et al.1987, 6: Czepiel 1974, 7: Jackson et al.1986, 8: Patti 1981, 9: Moriarty & Speckman 1984, 10: Newall 1977, 11: Sheth 1973, 12: Swan 1969, 13: Wilson & Mathews 1971, 14: Carter 1986

3.7. CONCLUSIONS & IMPLICATIONS FOR PRESENT STUDY

The studies, reviewed thus far, have indicated that innovations' attributes have been a subject of inquiry in adoption and diffusion research tradition and buying behaviour. However, while one has a relatively adequate knowledge of the determinants of perceived risk, yet little is known for other features of innovations. In this respect the following questions still remain:-

'Complexity, has been identified by Rogers and Shoemaker (1971) as the degree to which an innovation is perceived as relatively difficult to understand and use. While the need of an individual to know how to use an innovation is obvious, we know little about his need to understand the innovation. This in turn poses a lot of questions. First, what does the individual want to understand? The way it was produced? The way it functions or it is applied in a specific process? What are the components of it? Secondly, why the individual or the organization wants to understand the innovation? Does it imply a general psychological fear of buying and using something that cannot comprehend or merely the need to assure his ability in coping with future damages and breakdowns of the innovation irrespective of the willingness of the supplier to assist or not in the future?'

It is believed here, that research towards the answering of the above questions will provide a better conceptualization of complexity, as well as of other attributes, and will give rise to the second issue which is the identification of the determinants of complexity.

However, the above approach is not able to identify the possible inter-correlations among different innovation attributes and the relative magnitude of each attribute or groups of attributes on the different stages of the adoption process. To this end, with the exception of studies on the use of different information sources at different stages of the buying process, research has concentrated on a limited number of aspects of the adoption decision in each enquiry. This argument has been supported by Rogers (1983) and Vyas & Woodside (1984) who argued that more research is needed into the buying process as a whole, rather than individual aspects of this process. There are comparatively few reported studies of the organizational adoption decision which have implemented such a perspective in their methodology. Major exceptions are the work of Robinson et al. (1967), Corey (1978), Baker (1975), Abu-Ismail (1976), Griese & Kurpicz (1985), Avlonitis and Parkinson (1986). The study by Avlonitis & Parkinson (1986) examined the process of adoption of Flexible Manufacturing Systems in British and German companies by utilizing a conceptual framework built upon the model of industrial adoption suggested by Baker (1983). This model presents the organization's adoption decision as a sequential process, and it is expressed as:

$$P = f[SP, (PC, EC, (T_A - T_D), (E_A - E_D), BR)]$$

According to Baker (1985) PC is equivalent to awareness, EC to interest, $(T_A - T_D)$ and $(E_A - E_D)$ represents evaluation and BR represents the action taken while SP has the role of mediating the other variables and to communicate that the above is a process model.

Applying this model in their study Avlonitis and Parkinson (1986) found that selective perception was transformed to receptivity towards FMS mainly because of the practical compatibility of the FMS technology with the manufacturing technologies employed by the companies in their sample. Again compatibility with the companies' existing human and technical infrastructure was found to be a major enabling condition (interest). In addition they found that whenever FMS was regarded as highly compatible its complexity was regarded as low and vice versa. Due to high complexity and incompatibility perceived for FMS some companies did not proceed to the following stages and preferred to reject FMS for the present by adopting other less complex and more compatible manufacturing technology.

This evidence, although consistent with previous research findings (Zaltman et al. 1973) provide a new dimension for the investigation of innovations attributes. Indeed there is some clear evidence that attributes not only interact among each other but also that their magnitude is different at different stages of the buying decision process. In addition they are capable of enhancing or terminating the process at various stages of its development, rather than only at the evaluation or adoption stage as it is implicitly hypothesised in studies of innovations adoption or organizational buying behaviour.

To conclude, the preceding discussion has identified, inter alia, four issues on which further research should be directed, namely: 1) consideration of both tangible and intangible attributes of innovations as influential factors of adoption and diffusion of innovations, 2) consideration of the adopters' (buyers) perceived reasons underlying the relative importance of each attribute, 3) consideration of the possible intercorrelations among different innovation attributes and 4) consideration of the relative magnitude of innovation characteristics at different stages of the adoption/buying process.

The present study has been designed to take into account the above considerations. However, point 4 above was difficult to be assessed, owing to the snapshot view of the markets involved in the present study. Nevertheless, tangible and intangible characteristics of the innovations involved here are taken into account, the perceptions of adoptors and non-adoptors are considered explicitly and an attempt is made for a qualitative assessment of the reasons underlying the perceptions of adoptors and non-adoptors with regard to key tangible and intangible attributes of the innovations in this study[12].

Having explained the characteristics of innovation, their influence upon the adoption response of firms and the main issues to be considered in this study, the next chapter will examine the influence upon the adoption response of firms of economic and organizational/managerial factors.

[12] See Chapter 7, Sections 1 & 3 for the relevant discussion.

CHAPTER FOUR

THE BUYERS' SIDE FACTORS

ECONOMIC AND ORGANIZATIONAL/MANAGERIAL FACTORS

4.0. INTRODUCTION

As it was mentioned in chapter 1 of this thesis, substantial research efforts have been directed towards the factors influencing the innovativeness of organizations i.e. the degree to which a unit of adoption is relatively earlier in adopting new ideas than any other member of the system. These research efforts were based on the idea that organizations (similarly to individuals) possess certain characteristics (internally or in relationship to their environment) which mediate different adoption responses towards an innovation(s). The quest for innovativeness has been pursued mainly in two different schools of thought i.e. the economists and the behaviourists.

Economists, being influenced by their theoretical background and the prevailing views in the organizational decision making literature, utilized a rational economic perspective. Therefore rationality in decision making and attention on economic factors are the two main features of the economists' approach to organizational adoption of innovations.

Baker and Parkinson (1976) attributed the emphasis placed on economic factors to the following two reasons:- Firstly, economic theory predicates that firms seek to maximise the returns on the resources they employ, from which it follows that measurement of the economic benefit consequent upon adoption is seen as critical to the adoption decision. Secondly, economic factors are easier to identify and measure than other less tangible and non economic factors.

Regarding rationality Simon (1975) postulated, among others, that organizational decision making in buying situations can be characterized as purposive since it is guided by goals and objectives, and rational since it selects alternatives for the achievement of these objectives. This concept of choice has been substantiated by March (1976) who noticed that "most theories of individual and organizational choice behaviour accept the idea that goals exist and that (in some sense) an individual or organization acts on those goals, choosing from among alternatives on the basis of available information" (p.331). Furthermore, he argued that the decision making technologies, developed mainly during the past few decades, "have substantially improved man's capability for acting purposively, consistently and rationally" (p.331).

Baker (1985) attributed the economists' orientation in the study of buyer behaviour to Alfred Marshall who stressed economic motivations. However, Baker concluded that the Marshallian model "provides only a partial explanation of how buyers choose" (p.116). As such, Baker (1975) went one step further and suggested that the "understanding of the factors which influence the sequence in which firms adopt innovations can only arise from consideration of both economic and behavioural factors" (p.72).

In the industrial adoption of innovation research, behavioural factors include mainly organizational and managerial factors. To understand better the parameters of organizational factors Webster & Wind (1972) mention the work of Leavitt (1964) who perceived organizations as "multivariate systems composed of four sets of interacting variables: a) Tasks-the work to be performed in pursuing the organization's objectives, b) Structure-which consists of subsystems of communication, authority, status, rewards and work flow, c) Technology-which consists of problem solving inventions, plant and equipment and programmes for organizing and managing work, and d) People-who are the actors in the system" (p.14). They suggested that "these interacting sets of factors define the information, expectations, goals, attitudes and assumptions used by each individual actors in their decision making" (p.16).

Moreover, Webster & Wind (1972) maintained that "organizational factors cause individual decision makers to act differently than they would if they were functioning alone or in a different organization" (p.14). Knight (1967) postulated that structural properties of organizations influence the creativity of a person by determining his tasks and group behaviour. Finally, Webster (1969) argued that "the nature of the organization and internal communication can significantly influence the speed of adoption" (p.36).

With regard to managerial factors, Mansfield (1968b), although an economist, suggested that "the personality attributes, interest, training, and other characteristics of top and middle management may play a very important role in determining how quickly a firm introduces an innovation" (p.172). Similarly, Foxall (1984) called for recognition of the fact that the individual's perception of the organizational rules, operating procedures, managerial attitudes and the situational context of organizational behaviour fundamentally affect individual and group action.

Armed with the above insights, this chapter will present a selective review of economic and organizational/managerial factors internal to organizations that affect the adoption response of firms towards innovations. The chapter is divided in two sections. Section one, deals with the influence, upon adoption response of economic factors, and section two investigates the influence of organizational/managerial factors.

SECTION 4.1. : ECONOMIC FACTORS

Perhaps the most influential writer in the study of innovations from an economic perspective is Edwin Mansfield (1961,1963,1968a,1968b,1974,1989). His work has dominated the economists research tradition in this field and it is a main reference for every research or article that takes into account economic factors as explanatory variables of innovations. Therefore his work will be the starting point of this literature review and will guide the presentation of the works of other researchers who either supported or not his findings or introduced new economic issues in the study of innovations.

However, economic factors related to issues of cost and profitability of an innovation have been discussed in the previous chapter (Ch.3) and therefore will be excluded from this chapter.

Table 4.1 illustrates the economic variables that have been studied by Mansfield and other economists as well as, the work of other researchers, documented below, who investigated economic factors in their studies. The purpose of this table is to provide a better insight into the variety of economic factors that have been pursued in the literature. Part of this table has been originally produced by Baker and Parkinson (1976) and has been extended by the author.

Table 4.1: Economic factors associated with the adoption of industrial innovations

Authors	Factors Associated with Adoption of Innovations	Relationship	Statistical Significance
Mansfield (1961)	Profitability	Positive	Significant
	Size of investment	Negative	Significant
	Durability of existing equipment	Negative	Not significant
	Rapidly expanding output	Positive	Not significant
	Time	Positive	Not significant
	Phase of business cycle		Inconclusive
Mansfield (1963)	Size of firm	Positive	Significant
	Expected return from investment	Positive	Significant
	Growth rate	Positive	Not significant
	Profitability of firm	Positive	Not significant
	Age of firm's president	Positive	Not significant
	Liquidity of the firm	Positive	Not significant
	Decreasing profits	Positive	Not significant
	Market concentration	Positive	Not significant
Mansfield (1963)	Rate of return	Positive	Significant
	A measure of risk involved	Negative	Significant
	Size of the firm	Positive	Significant
	Liquidity	Positive	Significant
	Age distribution of existing stock	Negative	Not significant
	Number of firms has to buy to go from 10% to 90% adoption	Negative	Not significant
	Profitability of firm	Positive	Not significant
Muyer and Kuh	Liquidity and strong preference for informal financing	Positive	Not testd
O.E.C.D. (1970)	Profitability	Positive	-
	Sensity of demand for the product it produces to a reduction in price or improvement in quality	Positive	-
	Relative factor prices	Positive	-
Webster (1971)	Profitability	Positive	-
	Perceived risk	Negative	-
	Firm's size	Positive	-
	Liquidity of firm	Positive	-
	Managerial self-confidence	Positive	-
Mandfield (1968)	Total Assets	Positive	-
	Predicted revenue growth	Positive	-
	Debt to equity ratio	Negative	-
Metcalfe (1972)	Size of firm	Positive	Not significant
	Degree of vertical integration	Positive	-
	Quality of management	Positive	-
	No Q.S.E.	Negative	-
Peterson, Rudelius, & Wood (1972)	Past performance	Positive	Significant
	Recent performance	Positive	Not significant
	Sales growth	Positive	Not significant
	Risk propensity	Positive	Not significant
	Earlinees of adoption of two other innovations	Positive	Not significant
	Size of firm	Positive	Not significant
	Type of firm	Positive	Not significant
Ray (1969)	Time since new technology was introduced	Negative	-
	Profitabiltiy of new product	Positive	-
	Attitude of management	Positive	-
	Access to capital	Positive	-

(cont)

Gold, Peirce & Rosseger (1970)	Variations in level of output	Positive	-
Sutherland (1959)	Degree of certainty about the future prospects of the industry Labour shortage Quality of yarn Subsidy Cost of intalling	Positive Negative Positive Positive Negative	- - - - -
Bernhardt (1972)	Profitability Amount of information available	Positive Positive	Significant -
Romeo (1975)	Average rate of return fromthe investment in the innovation in the industry Number of firms in industry Variance of the distribution of firm size Total value of purchases of all new machinery in industry Average R&D expenditure in industry Size of the firm Profitability of innovation to the firm	Positive Positive Negative Negative Positive Positive Positive	Significant Significant Significant Significant Significant Significant Significant
Rosner (1968)	Organizational slack Economic orientation	Positive Negative	Significant Significant
Hastings (1976)	Size Profitability Liquidity Growth rate Profit trend	Positive Positive Negative Positive Positive	Significant Significant Significant Not significant Not significant
Ray (1989)	Need for new plant	Negative	-
Bernhardt (1970)	Demand for final product	Positive	Significant
Baker (1975)	Plant and Equipment replacement policy Sales volume Net profit Net worth Number of employees	Positive Positive Positive Positive Positive	Significant Significant Significant Significant Significant
Abu-Ismail (1976)	Size of firm (assets) Size of firm (sales) Size of firm (plant & equipment) Sales due to new products Existence of performance gap Firm's past performance in financial evaluation of new techniques and products	Positive Positive Positive Positive Positive Positive	Significant Significant Significant Significant Significant Significant
Carter and Williams (1958)	Quantified investment decisions High expansion rate Rapid machine replacement Good buildings Adequate finance	Positive Positive Positive Positive Positive	- - - - -

* Since the dependent variable is not the same for each study a positive relationship indicates a favorable influence of the factor to innovativeness or earliness in adoption and a negative relationship the opposite. The sign (-) indicates that the statistical procedures employed did not permit a test of significance.

4.1.1. ECONOMIC FACTORS AND THEIR INTERPRETATIONS

Economic factors have been interpreted as indicators of the existence of the necessary resources which allow a firm to attempt adopting innovations. Factors such as large size, profitability and liquidity of the firm, among others, have been used by economists to assess the relative adopting capabilities of firms (e.g. Mansfield 1968b, Schumpeter 1942). One can confidently characterise these explanations as purely economic.

However different authors have shown that these very factors that permit firms to posses substantial amount of resources either create obstacles to the adoption of innovations or they are indicators of other features of firms which can either impede or facilitate innovations. To this end it has been shown that, among other, large size can cause delays in decision making (Ettlie 1983a) and liquidity might be an indicator of the management's aversion to risk (Hastings 1976) or of an economic orientation of firms (Rosner 1968) which again does not favour innovations. By the same token large sized firms can afford, among other things, a larger diversity of specialists who can bring in the firm information which in turn facilitate the adoption of innovations. Thus economic factors mediate organizational behaviour which in turn impedes or facilitates innovations. Clearly, this second interpretation is a behavioural one.

Another version of a behavioural explanation states that economic factors create incentives to a firm for the adoption of innovations or even necessitates their adoption. In that respect, among other things, a profitable innovation is being seen as more favourable and thus it will be adopted earlier by a firm which suffers from profit decreases (Mansfield 1968b, March and Simon 1958, Duchesnau et al. 1979). Again, a firm with a high expansion rate and a rapid machine replacement policy that wants to expand its production capabilities might find this possible only through the adoption of innovations and thus, it will adopt earlier than a firm which is not expanding (Carter & Williams 1958, Cohn 1980, Baker 1975a, Avlonitis & Parkinson 1986).

This illustration of reasoning behind economic factors indicates that an economic and a behavioural explanation can be distinguished in the literature. To claim that both of them are valid one would expect a certain degree of convergent validity between the two modes of explanation when applied to the same situation. Alternatively one might argue that each explanation is more applicable to one situation than another insisting upon the inappropriability of applying two different modes of reasoning in the same situation.

However the empirical work in this field indicates that authors have used both explanatory interpretations on the same situation and concluded with contradictory results. Thus, although a performance gap can be interpreted as an incentive that fosters the adoption of innovations (behavioural argument, Duchesnau et al. 1979) it can also be seen as a factor that has decreased the available resources of the firm (Ettlie 1983a, 1983b) which in turn impedes innovations (economic argument). By the same token, a firm with increased profitability enjoys an abundance of resources and therefore, it can afford the adoption of innovations (economic), but at the same time due to its satisfactory performance it lacks the incentive for adopting innovations (behavioural).

Despite such contradictory interpretations, a tentative conclusion can be that existence of economic resources in a firm does not induce the adoption of innovations by itself. Using Metcalfe's (1972) argument regarding size one can say that, with caution, the existence of resources 'is a necessary condition for innovations but not a sufficient since much depend on management's outlook'. Moreover, following Webster's suggestions one can qualify Metcalfe's (1972) argument by stating, with caution, that existence of resources is a necessary condition only for innovations that are very costly in absolute or perceived terms. Therefore, for innovations which are cheap the importance of resources as a necessary factor for adoption is decreasing. This is an indication that if one perceives economic factors related to existence of resources as constraints rather than means, he might gain more useful insights into the process of adoption of specific innovations.

To this end, this semantic difference between constraints and means indicates that the influence of economic resources upon adoption is rather a matter of degree than of presence. Thus, when the economic resources exist (means), economic considerations of the type described above although present are of secondary importance to the adoption of innovations and therefore, can only explain a small portion of the variance in the innovative behaviour of firms and in the rate of adoption and diffusion of specific innovations. In contrast, when firms lack economic resources (constraints), economic considerations of the same type as above become of prime importance and therefore, are expected to explain a larger portion of the variance in the innovative behaviour of firms and in the rate of adoption and diffusion of specific innovations.

However these suggestions must be undertaken with caution which is justified by the following two reasons. First, economic resources interpreted in either way as means or constraints cannot explain how the actual preferences towards a specific innovation are formulated by the adoptors (Kotler 1972). Second, economic factors have been conceptualized in a very narrow manner and thus they overlook other organizational properties which can compensate a firm's lack of resources. Specifically recent advances in the transfer of technology have indicated that a firm can adopt innovations in many different ways, each of which has different requirements in economic resources. Thus a licensing agreement, a strategic alliance or merger, inter alia, are much cheaper means than purchase for acquiring an innovation, and therefore, even if a firm lacks the necessary resources, it can seek other ways in order to acquire an expensive innovation.

Similar arguments can be directed to the issue of economic incentives a firm faces in the adoption of innovations. Empirical findings indicate that these incentives have been interpreted as either an opportunity to resolve a problem or a necessity in order to achieve an objective. However this explanation overlooks the strategic alternatives a firm possesses in order either to resolve a problem or to achieve an objective as well as the real causes of a perceived problem. In that respect a firm with a high growth rate that wants to expand its production capabilities can achieve it not only through the adoption of innovations but also through contract manufacturing or mergers and acquisitions. Thus the argument that an expanding firm will be earlier in adopting innovations is if not irrelevant, susceptible to qualifications.

Besides, a low economic indicator of profitability or performance gap does not represent necessarily an economic problem. It may as well indicate a strategic manoeuvre of the firm which by suffering a decreasing profitability or a performance gap at the present time aims to increased profitability in the future. An example can be a firm that lowers its products prices either for reasons of penetrating a new market or in order to create barriers to prospective entrants. Thus the argument that a firm suffering from decreasing profitability or from a performance gap will have a strong incentive to adopt innovations is, again, if not irrelevant, susceptible to qualifications.

This lack of robust justification behind economists' arguments on the role of economic factors can be attributed mainly to the following two reasons. First the nature of the economic indicators and the way in which they were acquired (mainly from published data or annual firms' reports) has precluded a deeper understanding of the particular properties of firms and the strategic considerations faced by the firms' management. Second, the majority of studies that have taken into account economic factors have considered them as the only explanatory variables of the adoption and diffusion of innovations. Thus the effects from the interaction between economic factors and other variables which also have been found to influence innovations have remained largely undetected. The few studies which have addressed such issues have provided promising insights for the better understanding of the influence of economic factors upon the adoption and diffusion of innovations.

However it must be stated here that the purpose of the arguments presented above is to challenge the explanations provided by different authors regarding the influential role of economic factors on the adoption of innovations and not to argue whether or not such factors influence the adoption and diffusion of innovations. The empirical evidence supports the thesis that economic factors do in part influence the adoption of innovations, but are not in themselves conclusive.

The next section will therefore go on to investigate the influence of organizational and managerial factors upon the adoption response of firms.

SECTION 4.2. : ORGANIZATIONAL & MANAGERIAL FACTORS

In this section, will be examined the influence of organizational/ managerial factors and in particular those pertaining to the internal environment or internal characteristics of organizations. In essence, organizational/managerial variables are behavioural variables, and their emergence can be attributed to the suggestions of many influential writers on innovations.

The task of reporting the different organizational/ managerial factors (variables) and their relationship with the adoption of innovations as identified in the literature is a very difficult one. Indeed there is a plethora of studies and most of them are addressing different dimensions of organizations using different measures. In addition many studies investigate different types of innovations. The above diversification of research settings has indeed produced valuable insights into the process of adoption but has also resulted into many inconsistencies of findings which raise the question of the compatibility of results of one study with another. It is believed, therefore, that the best way to start this chapter is to attempt a classification of the different research approaches followed in the literature. Such a classification is presented in the following table 4.2 where the dominant research directions are illustrated alongside the authors that postulated and followed each of them.

As it can be seen from table 4.2 two levels of analysis have been utilized in the literature. Firstly, the 'macro' level which investigates the different structural modes of the organization as a whole and their effect on the adoption of innovations. Secondly, the 'micro' level which investigates the different structural modes of functional units of organizations (mainly the buying group structure) during the adoption of innovations (mainly the stage of source selection). It must be noted that early authors like Weber, Taylor and Fayol did not address explicitly the connection between structure and adoption of innovations. However their theses have determined to a large degree the dimensions and other properties of organizational structures which later became the main issues of research.

Table 4.2:Research directions and corresponding influential writers

INFLUENTIAL WRITERS	DOMINANT RESEARCH DIRECTIONS
THE MACRO LEVEL	
WEBER (19240 TAYLOR (1912) FAYOL (1916)	MECHANISTIC STRUCTURE
HAGE AND AIKEN (1967) BURNS AND STALKER (1963) LAWRENCE AND LORSCH (1967)	ORGANIC STRUCTURE AND CONTIGENCY APPROACH
ZALTMAN, DUNCAN & HOLBEK (1973)	STAGES OF THE ADOPTION PROCESS
BALBRIDGE & BURNHAUM (1975) MOCH AND MORSE (1977) DAFT (1978) ETTLIE ET AL. (1984)	DIFFERENT SETS OF VARIABLES & DIFFERENT TYPES OF INNOVATIONS
CARTER AND WILLIAMS (1958) BAKER (1975)	WIDER SPECTRUM OF ORGANIZATIONAL AND MANAGERIAL VARIABLES
ANSOFF AND STEWART (1967) FREEMAN (1974) MILES AND SNOW (1978)	THE ROLE OF STRATEGY
THE MICRO LEVEL	
DUNCAN (1971)	THE CONTIGENCY PERSPECTIVE
SPECKMAN (1979) CARDOZO (1980)	CONSTRICTION OF AUTHORITY PERSPECTIVE

4.2.1. ORGANIZATIONAL DIMENSIONS & MECHANISTIC STRUCTURE

The concept of mechanistic structure (called sometimes bureaucratic, formal or classical) emerged from the pioneering work of Taylor (1912), Fayol (1916) and Weber (1924). Weber, is responsible for the early developments of the bureaucratic model as an ideal type whilst Pugh et al. (1969), Litwak (1972) and Hall (1963, 1972) outlined the structural dimensions of the bureaucratic model. Weber (1924) sustained that bureaucratic administration means fundamentally the exercise of control on the basis of two types of knowledge: technical knowledge, acquired through training and experience and knowledge of facts. He added that the "spirit" of rational bureaucracy is characterized by formalism, which is essential, since otherwise the "door would be open to arbitrariness and hence formalism is the line of least resistance" (p.15).

However, the concept of bureaucracy has been attacked by many authors including Weber himself. Bennis (1972) and Thompson (1972), among others, stated that the bureaucratic organizational form was well suited to the social and economic conditions prevailing during the time of its conception. They postulated that since these conditions have changed, organic adaptive structures are emerging in order to cope with the increased demand of balancing individual goals with organizational objectives and keeping abreast with the rapid environmental changes dictated by technological advancement.

4.2.2. ORGANIC STRUCTURE AND CONTINGENCY THEORY

The notion of organic structure is based upon the findings of Burns and Stalker's (1961) widely cited study of electronics firms in Scotland which sought the relationship between environment and structure. Segmenting the environment into a dichotomy of stable and unstable, they identified two different management systems, namely mechanistic and organismic. They concluded that the mechanistic system is most appropriate for firms operating under stable conditions. In contrast an organismic system is most appropriate for firms operating in a less stable environment where the need for additional information and interpersonal communication is very important during task execution. Evidence in support of their view is provided by Galbraith (1986) who observed that as the level of task uncertainty increases, the amount of information to be found and processed by decision makers increases too. He postulated that changes in the organizational structure of firms represent the strategic efforts of firms for processing information. Therefore a mechanistic structure is implemented because tasks are routine and predictable while an organic structure is used when the level of uncertainty is higher and the mechanistic rules and procedures cannot cope with the demands of this situation.

The findings of Burns and Stalker helped Lawrence and Lorch (1967) to develop their contingency theory where they suggested that there is no one best way for firms to organize. They found that the conditions of the external environment determined differences in decision making structures utilized not only by different firms but also by different functional units within the same firm.

These early studies on the organic structure of organizations are not explicitly related to the adoption of innovations. However, implicitly, they provide evidence that the necessary conditions in organizations for the adoption of innovations can be achieved best by an organic structure. Among the first researchers to address explicitly the influence of organizational factors upon the adoption of innovations were Hage and Aiken (1967). The underlying assumption of their studies is that specific organizational configuration are most likely to be associated with a high rate of programme change.

The work of Hage and Aiken is based on the ideas described by Hage (1965) in his "Axiomatic theory of organizations". Due to their pioneering work, the following discussion in this part presents their findings regarding centralization and formalization as well as the main explanations offered by them when seeking to explain the relationships of these organizational characteristics with the rate of programme change.

4.2.2.1. FORMALIZATION

Formalization is defined as the degree to which an organization emphasizes following rules and procedures in the role performance of its members (Rogers 1983).

Hage and Aiken (1967) predicted a negative relationship between formalization and the rate of programme change. They postulated that high formalization discourages individual initiative towards change because: 1). close supervision to ensure conformity with rules reduces the search for better ways of doing things and 2). rigid rules give the impression that there is no better way tasks could be performed thus encouraging a ritualistic and unimaginative behaviour. However, their empirical results were inconclusive. The explanation offered by Hage and Aiken is that "there may be an optimal rate of innovations which the organic organization can incorporate without altering the techniques of social control...if the rate of innovation is too rapid, more rigid, inflexible mechanisms of social control might have to be used to implement innovation" (Aiken & Hage 1971, p.76). They concluded that innovative organizations have some elements of the organic model and some elements of the mechanistic model, which is a clear appreciation of the views shared by advocates of the contingency approach to management of organizations.

4.2.2.2. CENTRALIZATION

Centralization has been defined as the extent to which decision-making power is concentrated at the top of the organizational hierarchy and in the hands of relatively few individuals. Hage & Aiken predicted that the higher the centralization the lower the rate of the programme change. The supporting arguments for this are:- 1). individuals with power are reluctant to engage in themselves in programme changes because they might loose their power due to the risks involved with experimentation; 2). less centralization permits the participation of many individuals in the decision making process and therefore the variety of occupational perspectives and information sources involved identify new areas for change; 3). more decentralization leads to conflicts in occupational perspectives which give rise to areas for change; 4). lower level managers are able to pursue their ideas more rigorously and thus they can overcome any resistance or hostility to change coming from top management.

Two aspects of centralization were investigated by Hage and Aiken: 1). the degree of centralization of agency-wide decisions i.e. decisions about the control of resources (hiring and promoting personnel, adopting new policies, programmes and services), 2). the degree of centralization of job decisions or 'hierarchy of authority' i.e. decisions about the control and performance of a specific job. Overall, they found positive relationships between decentralization of only agency-wide decisions and rate of programme change but this relationship was weaker for the period 1964-66 than for the period 1959-63. They attributed this finding to the fact that the rate of innovation was higher for the period 1964-66 and therefore, less participatory management styles were used in order to implement the increased rate of innovations. Furthermore they postulated that only the degree of centralisation of agency-wide decisions is relevant to programme changes since such changes are related to the deployment of resources and the employment of new personnel.

Kim's (1980) findings accord with those of Hage & Aiken but with some very important differences. Specifically, whereas Hage & Aiken found decentralization of resource allocation decision making to be related with the adoption of programme changes, Kim found centralization of only hierarchy of authority to be negatively related to the adoption of product changes. He explained this inconsistent finding by using the Downs & Mohr's (1976) argument who stated that the influence of centralization relevant to innovation depends upon what is decided. Thus for programme changes that necessitate the addition of personnel and resources, centralization of agency-wide decisions is relevant. But for product changes which require assessment of the market and technological opportunities at work, hierarchy of authority (i.e. job decisions) is more relevant.

Based on the findings of the already mentioned authors and others such as Woodward (1965), Pugh et al.(1969a,1969b), Hinnings and Lee (1971), the prevailing view in the literature was that:- 1).the organic organizations are best suited for small-scale, complex work while mechanical organizations are best suited for large-scale, simple work; 2).the mechanical type of organizations has the best opportunity for maximizing productivity while the organic type has the greatest potential for stimulating innovations.

However further empirical evidence demonstrated that organic conditions hypothesized to stimulate innovations were in fact impeding their final adoption and implementation.

4.2.3. ORGANIZATIONAL DILEMMA IN THE ADOPTION PROCESS

To begin with Wilson (1966) and Sapolsky (1967), among others, found that while decentralization of decision making authority and the existence of a large number of equally situated subunits and highly professionalized personnel were acting in favour of the conception and suggestion of many proposals for innovations, the very same conditions frustrated attempts to implement these proposals. Corwin (1972) found that centralization of decision making and technological change were positively related. He argued that centralization provides the capacity to organizations to select and enforce innovations.

Hage & Aikens's stance on the 'organizational dilemma' was that despite any problems inherent in an organic system, overall, it has more potential than a mechanistic system for the implementation of innovations. However, Shepard (1967) stipulated a different perspective. He put forward the view that an organization that wants to adopt innovations needs different organizational qualities at each stage of the innovation adoption process. Specifically, he postulated that for the generation phase of an innovation, the organization needs a quality of openness so that diverse and heterogeneous persons can contribute, and alternatives can be explored. For implementation, the organization needs, among other, singleness of purpose, functional division of labour, responsibility and authority, discipline, and the drawing of internal communication boundaries. Clearly the conditions for the generation phase are closer to an organic structure while for the implementation phase are closer to a mechanistic system. In the present discussion this is the second version of the organizational dilemma. The ideas of Shepard were followed and advanced further by Zaltman, Duncan and Holbek (1973). Indeed, Zaltman et al. while supporting the view of Hage and Aiken (1971) regarding the overall potential for innovations of an organic structure, attributed the controversy of the 'organizational dilemma' to the different conditions that arise or are necessary during the different stages of the innovation adoption process(i.e. initiation and implementation). They argued that each stage of the innovation process has different requirements, serves different purposes and within each stage different factors opposite to innovations are in effect.

Similarly, Downs and Mohr (1976,1979,1984) postulated that inconsistent findings in the study of innovation have been produced because the different stages of the innovation process have not been taken into account. However Downs & Mohr (1976) argued also that instability of research findings on the adoption of innovations was due to the existence of different types of innovations. Thus, factors important for the adoption of one type of innovations are not necessarily important for others.

4.2.4. DIFFERENT TYPES OF INNOVATIONS AND SETS OF VARIABLES

Researchers have studied different types of innovations based on the argument that different types have different requirements in terms of, among other things, organizational structures, managerial attitudes and practices, information exposure and human capital. As such, researchers have documented different predictor variables of innovations compatible versus non-compatible with the interest of lower level personnel (Moch & Morse 1977), administrative versus technical innovations (Evan & Black 1967, Daft 1978), technical versus administrative versus ancillary (Damanpour 1987), evolutionary versus revolutionary (Cohn & Turyn 1984) and radical versus incremental innovations (Ettlie 1984, Dewar & Dutton 1986).

Cohn and Turyn (1984) studied the adoption behaviour of 50 firms in the footwear industry. They concluded that the most important variable affecting adoption was complexity while decentralization and informality were found to be weakly related to adoption. Further analysis of the adoption behaviour of firms when the innovations were discriminated into evolutionary or revolutionary suggested that complexity was positively related to the adoption of both types of innovations while centralization and formalization were positively related only to the adoption of revolutionary innovations. They attributed these results to the specific characteristics inherent in the footwear industry. Specifically, they found little conflict during the adoption decision process because: 1).the innovation offered in the industry were mostly evolutionary and thus their evaluation was relatively easy; 2).participation in the decision process was restricted to managers in production and the C.E.O. thus there was little interdepartmental conflict, and 3).the leasing option for acquiring the innovations reduced the risk involved in an incorrect decision.

Clearly, the study by Cohn & Turyn provides support to the argument that both contextual conditions in the industry and the type of innovations affect the relative importance of the organizational variables on the adoption process of innovations. Similarly, Shepard (1967) argued that structural changes are not enough by themselves to create innovative organizations. He postulated that "what is needed is a change of attitude and receptivity of managers who due to traditional methods of education and experience in mechanistic organizations have lost the creativity and ability to adapt in changing situations". On the same lines, Twiss (1986) argued that "the best theoretical organization will fail if unsupported by effective managers and conversely, good management can obtain results even when working within unfavourable organizational structure". Furthermore Twiss sustained that "top management plays a critical part in creating organizational attitudes favourable to innovation...".

Supportive evidence of a positive relationship between managers' attitude and receptivity to innovations has been provided, among others, by Carter & Williams (1958), Rothwell (1977), Baker (1975), Ozanne and Churchill (1971). More specifically, Ozanne and Churchill found that the way in which firms respond to innovations depends to a great extent on personal characteristics of managers such as education, previous experience, cosmopoliteness, mental abilities and technical orientation.

Hage and Dewar (1973) noticed that literature has not taken into account the influential role of elite values, leader and member values upon the organizational adoption of innovations. They postulated that irrespective of structure, elite values "represent a guiding force in the organization, which can change its direction, set policy and introduce change" (p.286).

Balbridge and Burnham (1975) examined the adoption of innovations in school districts in the San Francisco Bay Area and Illinois. The variables used to predict schools' behaviour were individual, organizational and contextual variables. Surprisingly, Balbridge and Burnham found no relationship between innovations adopted and characteristics of individuals. From the organisational variables, size and complexity were strongly and positively related with innovative schools. From the environmental factors however, only a factor representing environmental heterogeneity, derived through orthogonal factor analysis, presented a positive relationship with innovations adopted.

Kimberly and Evanisko (1981) studied the adoption of 12 technological and 8 administrative innovations in hospitals. To explain the difference in the adoption behaviour of each hospital they utilized three set of predictor variables, organizational, individual and contextual variables. Kimberly and Evansisko concluded that organizational variables were better predictors than individual and contextual variables. Furthermore, it was found that different sets of variables were influencing different types of innovations. However the educational level of the hospital administrator, the size of the organization and the presence of competition in the local environment were significant predictors for both administrative and technological innovations.

The above studies investigated the effects of organizational factors on the adoption of different types of innovations, as well as the combined effects of different sets of variables (organizational, managerial, contextual). However no single study reviewed thus far has taken a more holistic approach where along with different types of innovations and different sets of variables the stages of the adoption process were taken into account. To this end two studies, a theoretical and an empirical one, deserve attention.

The theoretical study is the one conducted by Pierce and Delbecq (1977). By means of an extensive review of the literature they concluded that organizational, individual and contextual variables have different influence in different stages of the innovations process. Regarding organizational factors they postulated that while, overall, an organic structure is more conducive to innovations than a mechanistic structure, due to the organizational dilemma organizations need some properties of both systems in order to perform efficiently in different stages of the adoption process. Since for the organization as a whole it is difficult to change at each stage they suggested matrix organizational systems or the creation of venture teams. Thus, a mechanistic organization that wants to be innovative can institute an 'organic overlay' in order to assist the provision of innovative ideas. By the same token an organic organization that wants to facilitate adoption and implementation must create a 'mechanistic overlay'.

The empirical study is the one conducted by Zmud (1982). By studying the adoption and diffusion process of modern software practices he found centralization to be positively related to initiation adoption and implementation of both technical and administrative innovations. Formalization was found negatively related to the initiation of technical innovations but positively related to the initiation adoption and implementation of administrative innovations and the adoption and implementation of technical innovations. Furthermore, it was found that formalization had a stronger influence upon technical innovations than upon administrative innovations.

4.2.5. THE WIDER SPECTRUM OF ORGANIZATIONAL AND MANAGERIAL FACTORS

In contrast with the above studies, which dealt with specific and limited number of variables, this stream of research is characterized by the plethora of organizational/ managerial and other factors which have been utilized for the explanation of the innovative behaviour of firms. It has been initiated by the pioneering work of Carter and Williams (1958) who attributed the technical progressiveness of firms to their organizational and managerial characteristics.

A study similar to Carter and Williams is the one conducted by Cohn (1980). Cohn used many of the variables identified by Carter and Williams in an attempt to identify the innovative firms in the footwear industry. Although many of the Carter and Williams' findings were not supported in his study, Cohn concluded that innovative or technically progressive firms:- 1).employ more intermediate managers in production but not in the firm as a whole; 2).have an open formal communication structure but not a more open informal one; 3).employ a higher proportion of managers with MBA's but not a higher proportion of managers with college degrees.

On the same lines, Rocha et al.(1990) tried to identify the characteristics of innovative firms in the Brazilian computer industry. They found innovative firms to be larger than non-innovative firms, younger, with more employees allocated to R&D and more active in exports. In addition the CEO in innovative firms was technically well educated, owned a significant portion of the company, had more contact with developed countries and along with the marketing managers had more years of experience in the industry.

Finally the work of Carter and Williams provided the initiative to Baker's (1975a) own study, who by theorizing an adoption decision process model investigated the influence of a large and diverse number of organizational and managerial factors. Baker became a very strong supporter of the importance of organizational and managerial factors in the innovations' adoption decision of firms and suggested more research on the issue. His suggestions were followed by a large number of researchers mainly based at the University of Strathclyde, the "Strathclyde group" in Baker's own words. Among these researchers are Parkinson & Avlonitits (1986), Abu-Ismail (1976) and El-Sherbeny (1978).

Both, Abu-Ismail and El-Sherbeny studied the adoption of the tufting process in carpet industry. The traits of early adopters (or tufters) as they have been produced by the work of Abu-Ismail are illustrated in the table 4.3.

Despite the low level of relationships of the independent variables, used by Abu-Ismail, with the elapsed time of adoption, the majority of them accord with the relationships hypothesized by the author. Similar results have been produced by El-Sherbeny and in spite of the fact that neither different types of innovations or adoption stages were taken into account the consistency of the results indicated a very promising area for future research.

Similarly Avlonitis & Parkinson (1986) found in their study of adoption of flexible manufacturing systems that senior management in innovative companies has a formal technical education and training which fostered their receptivity to innovations. Interestingly, they also found that senior managers were outward looking, had established many personal contacts with suppliers and users of FMS, were consulting regularly reports, trade journals and other sources of information. Above all it was found that this orientation of managers which is near to organic conditions was frequently embodied in the managers' job specification, a kind of 'formalized organicity' in other words.

Table 4.3

VARIABLES	HYPO-THESIZED RELATION	Kendal's Tau
Centralization in decision making	-	-0.003
Centralization of authority	-	-0.466
Formalization (Job specification)	-	-0.212
Formalization (Communications)	-	-0.139
Formalization (Rule observation)	-	-0.302
Communication among members	+	+0.068
Participation in decision making	+	+0.016
Integration between production and marketing	+	-0.161
Integration between production and technical/development dep.	+	-0.145
Integration between marketing and technical/development dep.	+	-0.136
Unprogressive recruitment policy	-	-0.057
Unprogressive training policy	-	-0.449
Incentives for innovative ideas	+	+0.164
Long period of marketing plan	+	+0.035
Number of persons employed full-time in marketing research	+	+0.099
Managers attitude towards marketing	+	+ scale
Inability to make modifications on new processes/techniques	-	-0.103
Number of published articles	+	+0.381
Number of persons employed full-time on technical development	+	+0.063
Firm's past performance on the technical evaluation of new techniques	+	-0.091
Creativity	+	+0.236
Cosmopoliteness	+	+0.027
Opinion leadership	+	+0.141
Leadership in accepting innovations	+	+0.106

Source: Abu-Ismail (1976)

4.2.6. THE ROLE OF STRATEGY

Foremost among the works linking innovation rates and strategy are those of Abernathy and Utterback (1978) and Utterback and Abernathy (1975). These researchers have linked patterns of innovation (product, component or process innovation) to the methods of production employed at different stages of the industry life cycle, capital intensity of the firm, market share realized, type of R&D and competitive intensity in the industry.

Generally, this link is acknowledged to be of a complex, multivariate, nonrecursive, dynamic and asymmetric nature (Abernathy and Utterback, 1978, Schroeder, 1990).

However, most research on the linkage between technological innovation and strategy has been concerned with the practices and problems of innovators (i.e. firms producing innovations). This research can be found mostly in the strategic management literature. It follows a taxonomic approach to the research problem and attempts to make sense of the above complexity by developing typologies of technology-strategy gestalts. This approach has identified and isolated frequently occurring configurations of extremely crucial elements of organizational reality. These elements seem to form common gestalts such that each can be best understood in relation to the other elements in the configuration. As such, the research impetus in this area is based upon the belief that organizational and strategic typologies are predictively useful. That is, if only a limited number of archetypes occur, we may, by looking at certain features of an organization, be able to deduce its archetype membership, and thereby predict many of its other characteristics (Miller and Friesen, 1978).

Miles and Snow (1978) postulated that an organization's strategy is traceable in three domains: the entrepreneurial, which is linked to the way the organization orients itself in the marketplace; the administrative, embracing how the organization attempts to co-ordinate and implement its strategy; and the technical, which refers to the technology and processes used to produce the organization products and services. According to their strategic typologies, a firm following a prospector strategy adds to and changes its products and services, consistently attempting to be first in the marketplace. Such a firm stresses innovation and flexibility in order to be able to respond quickly to changing market conditions. It exists in a state of flux and constant change. An analyzer's strategy attempts to maintain stability and efficiency in one arena even as they attempt to adapt and remain effective in another. A defender's strategy has a narrow product-market domain. It emphasizes tight control and continually looks for operating efficiencies to lower costs. Finally, a reactor firm is slow, unable, or unwilling to make changes in its product-market domain. Miles and Snow examined interrelationships of various attributes within each strategic type e.g. product/market entry behaviour, technology, structure, managerial processes and power distribution.

Similarly, Miller and Friesen (1982) have shown how strategy and innovation are linked to each other in two very different models of strategic momentum, a "conservative" and an "entrepreneurial".[13]

Table 4.4 illustrates a selective review of the many strategic typologies developed in the literature.

[13] Others have chosen to examine individual strategies alone. Lefebvre et al. (1991) examined, among other things, the relationship between innovativeness (measured as number of innovations adopted) and a number of manufacturing and competitive strategies pursued by the firm during the adoption decision process. They found less innovative firms to be cautious, conservative and rather inwardly oriented in their technological decisions. More innovative firms appeared to be after longer term, less quantifiable gains in flexibility and quality of service. When trying to reach an adoption decision they tend to look more outside at the needs of their clients. Lefebvre et al. suggested that "as the company's experience with technology grows, the decision making process moves in the direction of putting more weight on factors which are more closely related to the true potential of the technology, that is addressing the needs of the client, looking at long-term strategic advantage, and striving to achieve more flexiblity and reduce the introduction time for new products" (p.247).

Table 4.4 : Strategic typologies

Ansoff & Stewart (1967)	Freeman (1974)	Urban & Hauser (1980)	Miles & Snow (1978)	Johne (1982)	A. Miller (1988)	Capon et al. (1992)
First to market Follow the Leader Applications Engineering Me-too	Offensive Defensive Imitative Dependent Traditional Opportunist	Proactive -R&D based -entrepreneurial -acquisitive -marketing based Reactive -responsive -imitative -second but better -defensive	Prospectors Analysers Reactors Defenders	Broad-span innovators Narrow-span innovators Uncommitted Positionals Committed Positionals	Innovative Batch Unaltered Process Established Batch Modified process Flexible Line Fixed line	Investors Process Innovators Non-Innovators Acquirers

The Miles and Snow's typologies were validated by Hambrick (1983) who used both the relative and absolute percentage of sales accounted for by new products in order to classify firms as prospectors or defenders. Ansoff and Stewart (1967) classified firms into typologies according to their timing of entry into an emerging industry and Freeman (1974) used primarily the level of firm's R&D expenditures for discriminating the various responses of firms to technological change. Recently, Miller (1986) offered, on the basis of a review of the literature, a list of representative strategic variables (see Table 4.5) which are included within each of four broad categories of variables that reflect important competitive strategies e.g. differentiation, cost leadership, focus and asset parsimony. As it can be seen from this table, the timing of adoption of innovations is not included explicitly in any of these competitive strategies and the same holds for the majority of the strategic typologies developed in the strategic literature.

Table 4.5 : Representative strategic variables

Differentiation	Focus	Cost Leadership	Asset Parsimony
Innovation: - Percentage of sales from products introduced over last 2 or 3 years. - R&D as percentage of sales. - Average age of products. - Frequency of major product changes. Marketing: - Product quality. - Product image. - Marketing expenses. - Advertising & Promotion. - Sales force. - Service quality.	Product line breadth Breadth of customer types Geographic coverage	Relative directive costs/units Newness of plant and equipment Product pricing Capacity Utilization Backward vertical integration Process R&D	Fixed asset intensity (gross book value of plant and equipment revenues) Current asset intensity (current assets/revenues)

Source: D.Miller (1986)

The relevance of the above studies with the adoption of innovations is best expressed by Johne (1984a). Johne examined the product innovation practices of 16 firms manufacturing and marketing electrical and electronic test and measuring instruments in the UK. He found firms in the innovative mode to have adopted two product classes (silicon chips and microprocessor units) ahead of firms in the positional mode. As such, he suggested that differences in product innovation strategies among firms can be used by suppliers of innovations for macro segmentation purposes. In addition Johne found that innovator firms follow different organizational structures than positional firms for initiating and implementing product innovations. The latter is in accordance with the suggestions and findings of the previously mentioned authors who follow a taxonomic approach. Johne maintained that such differences in organizational structures can be used by supplier firms in the formulation of their selling tactics. Overall, Johne (1984a) argued that suppliers of advanced component products can find it advantageous to purposively seek out customers who are also innovators since "after all, it is almost tautological to suggest that innovator firms will buy advanced components ahead of positional firms" (p.61).

However, there is something to the latter conjecture as well as to the argument that strategic postures may be used for the prediction of other elements of the organizational reality such as structural arrangements.

Firstly, Utterback and Abernathy (1975) classified firms into three stages as following.

Stage I : *uncoordinated process, product performance-maximizing strategy*; it includes firms attempting to be the first in introducing advanced products.

Stage II : *segmental process, sales-maximizing strategy*; in this stage firms watch others innovate but at the same time are prepared to quickly adapt and introduce new product variations and features.

Stage III : *systemic process, cost-minimizing strategy*; here firms enter the market later in the product life cycle with simpler and less expensive versions of the product.

Utterback and Abernathy found that three-quarters (74.2%) of the innovations introduced by firms in Stage I were original products and components while half (50.8%) of all innovations introduced in Stage III were wholly adopted from other firms. While there were few process innovations in Stage I (21 cases, 12.1%) as large a proportion of process and product innovations were original (18 of the 21). These results supported Utterback and Abernathy's hypothesis which stated that "most innovations introduced by firms in Stage I will be original, while in Stage III most will be adopted (from material suppliers, equipment suppliers, by license, imitation etc." (p.651). This finding indicates that the adoption behaviour of firms in stage I (performance-maximising) toward innovations produced by other firms (suppliers) is minimal. Their products result mainly from own engagement in R&D activities rather than from the adoption of innovations (product, components or processes) which have been developed and introduced by their suppliers. The opposite holds for firms in stage III (cost-minimising firms). This in turn, is in sharp contrast with the assertion that innovator firms (performance-maximising firms in this case) will adopt advanced components ahead of positional firms (cost-minimising in this case).[14]

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[14] Caution is suggested here since Utterback and Abernathy validated their hypothesis by using Mayers and Marquis's (1969) data of 567 successful innovations and as such only surrogate indicators are reported. Thus, one does not know the timing of innovation adoption and the extent to which R&D activities of performance maximising firms have been aided by the adoption of technology and innovations produced elsewhere.

Secondly, Johne (1984a) conditioned his suggestion regarding timing of advance components adoption by stating that "innovator firms will normally tend to lead in the adoption of new advanced components when these are *relevant*[15] to their marketing needs" (p.61). This conditioning is in line with Porter's (1983) assertion that innovation can be used to support any of his generic strategies as long as the innovation provides benefits consistent with that particular strategy[16].

Similarly, Schroeder (1990) argued on the basis of empirical findings that the patterns of an innovation's adoption and use differ among strategic groups since each adopts the new technology to align with their specific strategic posture. He postulated that the innovation's ongoing development, the emergence of complementary innovations and the innovation's gradual diffusion act jointly to create an innovation's complex shifting impact upon a firm. As such, typologies based on adoption timing are difficult to integrate directly with competitive strategies and fail to encompass the complexities of an innovation's shifting impact (Schroeder, 1990).

This new approach to the linkage between strategy and adoption of innovations seems to gain considerable ground in the strategic literature.

However, as Schroeder (1990) noted, empirically supported theories on the linkages between innovation and competitive strategy have been slow to develop, largely because of the complex relationship between the two. Recently, Shortell and Zajac (1990) attempted to assess the reliability and validity of Miles and Snow's strategic types by collecting empirical data from over 400 organizations in the American hospital industry. They were able to validate Miles and Snow's strategic types however, only with regard to their administrative and entrepreneurial components. As to the technical component of these strategic types and their predictive validity they concluded that additional research is needed in order to answer

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[15] Italics added.

[16] A somewhat similar approach has long been used in the innovation diffusion literature. Rogers and Shoemaker (1971) refer to the compatibility of the innovation with the needs of potential adopters as a prime determinant of the innovation's acceptance and diffusion. Again, as it was reported in Chapter 3 Downs and Mohr (1976) suggested that "neither the organization nor the innovation would be described as compatible, for example, but rather the pair taken in conjuction" (p.706).

questions such as: "Are prospectors and analyzers likely to adopt an innovation earlier than defenders? Does this timing depend on the type of innovation?" (p.829). According to Shortell and Zajac perhaps prospectors are more likely to be early adopters of *programmatic* innovations like new products or services, analyzers more likely to be early adopters of *managerial* innovations (for example, a new management information system), and defenders more likely to be early adopters of *technical* innovations like a new production technology (Shortell and Zajac, 1990, p.829).

Finally, to the argument that strategic postures may be used for the pre-diction of other elements of the firms' reality, such as structural arrangements, there exist contradicting views in the literature. These range from Chandler's (1962) famous edict that 'structure follows strategy' to the other extreme that 'often strategy may follow structure' (Miller 1986, Mintzberg 1978).

Mintzberg (1978) thought of strategy formation as revolving around the interplay of three basic forces: an environment that changes continuously, an organizational operating system or bureaucracy that seeks to stabilize its actions despite the characteristics of the environment it serves and, a leadership whose role is to maintain the stability of the organization's operating system while at the same time insuring its adaptation to environmental change. Within this triangle Mintzberg viewed strategy as "the set of consistent behaviors by which the organization establishes for a time its place in its environment" and, strategic change as "the organization's response to environmental change, constrained by the momentum of bureaucracy and accelerated or dampened by the leadership" (p.941).

Mintzberg perceived structure as having something of a life of its own. His ideas about strategic change bring new useful insight to the field of innovations. Indeed, technological innovations are capable of revolutionalising markets and demand thus, creating new industries and transforming or destroying existing ones (Shanklin and Ryans 1984, Cooper and Schendel 1976). This very nature of technological innovations is capable of severely disturbing the desired matching of strategy and structure as well as of other elements of any strategic or organizational typology. It can create conflicts among elements in the typology thus altering their relationships. This in turn, obfuscates any attempts to predict firms' response towards an innovation based solely upon the categorization of these firms into a strategic typology in the past.

4.2.7. THE MICRO LEVEL OF ORGANIZATIONS

In contrast with previous research efforts which examined the structure of the organization as a whole, studies reported in this section focus on the structure of smaller organizational decision units such as departments, work units and buying groups. The significance of these studies lies on the fact that, contrary to contemporary theoretical and empirical assertions in favour of the contingency theory, some of them detected other organizational settings.

To begin with, Duncan (1972) studied the relationship between structure and environmental uncertainty in smaller decision units within organizations (departments and work units). He found that, under conditions of low uncertainty a bureaucratic structure was implemented whereas more organic structures were dominant when the degree of uncertainty increased. Duncan's work accords with the principles of the contingency theory and similar results have been reported by Speckman (1979). Speckman found a significant positive relation between uncertainty and the degree of participation in buying groups. However, Speckman found little evidence in support of the contingency theory regarding the other structural dimensions. His findings did not produce any relation between uncertainty and formalization and in addition the observed relationship between uncertainty and centralization was positive. Similarly, Khandwalla (1972) found that environmental hostility causes centralization of decision making.

Speckman's findings were a first indication of the yet unexplained situation where increased task uncertainty caused concentration of authority and structural schemata of the smaller organizational units closer to a bureaucratic system than to an organic one. In support of this, Cardozo (1980) found that, whereas purchasing personnel of buying organizations had major responsibility in the buying process in the case of straight rebuys, their dominance was shifted to line managers and technical specialists in the case of modified rebuys and in the case of new tasks, where uncertainty was highest, top management was involved too.

However he found that increasing levels of uncertainty were leading to larger units with greater participation, a finding in support of the contingency approach.

Similarly, Bourgeois et al. (1978) found, in a study involving a large number of individual managers, that under stable conditions they responded more organically while under unstable environmental conditions more mechanistically. In addition when individuals acting in a stable environment were confronted with unstable conditions they shifted to a mechanical system but not the opposite. These findings were explained by Bourgois et al. as a desire of individuals to increase control in any changing situation since change creates uncertainty. Such results were attributed by McCabe (1987) to the constriction of authority perspective as opposite to contingency theory . In his own study, he found a tendency of top managers to centralize the decision-making process in response to high levels of product complexity and perceived task uncertainty. In addition he found that the higher participation of persons in the case of increased uncertainty was serving the need for more information while the actual number of people exercising real authority in the decision process was limited. In somewhat different terms, Dutton (1986) postulated an increase in centralization of decision making under conditions of crisis.

Apparently, studies in the micro-level of organizations seem to contradict findings from the contingency theory. However, one can attribute such contradictions on the following two issues:- a) researchers of the micro-level have not taken into account the different substages of the adoption process. Instead they have concentrated on the decision substages and in particular, on the selection of the supplying source, b) the contigency theory at its early development was based upon the organization as a whole and not its subunits. However, early in this chapter the work of Hall (1963,1972) and Litwak (1972) was reported who, among others, suggested that internal structural segments of organization may differ in their degree of bureaucracy. More recently Mintzberg (1983) subscribed to that view and stated that "although we can characterise certain organizations as bureaucratic or organic overall, none is uniformly so across its entire range of activities" (p.37). Therefore one may conclude that some of the contradicting findings mentioned above are not real ones but have resulted because of differences in research settings and comparisons between issues where differences were expected (whole organization versus its subunits).

Moreover, the differences between the organization as a whole and its subunits were appreciated by Holbek (1988) and were attributed by him to the efforts of organizations to make use of the advantages of organicity and bureaucracy for the initiation and implementation stages of innovations respectively. Holbek, postulated that the dilemma between bureaucracy and organicity is faced by organization through solutions involving differentiation in time, differentiation in space and hybrid solutions (i.e. balanced differentiation in space and time). Furthermore he suggested that in order to gain better insights into the problem of organizational dilemma, "measurement of organicity or bureaucracy must be made for the relevant organization units, as well as for the organization as a whole" (p.274).

4.2.8. THE CASE OF SMALL FIRMS

The majority of the studies reviewed above refer to large organizations and comparatively little research has been done in small and medium-sized firms. Therefore, the question whether the structural properties investigated in large firms have similar effects on the adoption of innovations in small firms remains largely unanswered.

To my knowledge, there exist only a few attempts comparing explicitly the organizational properties of small versus large firms as they relate to the innovative behaviour of organizations. Among these studies is the one conducted by Koehler and Tebbe (1985) regarding the organizational structure and behaviour of 56 innovative German enterprises of which 9 were of small and medium size and 47 were of large size. Their results indicated that small and medium firms had a lower degree of delegation (i.e. high centralization) than larger firms, a lower degree of specialization below the top management level but more unrestrained informal channels of communication than large firms. Regarding the degree of formalization they did not find any significant difference between small and large innovative firms although this variable showed a substantial positive relationship with large firms and a negative one with small and medium firms. Koehler and Tebbe found that small and medium firms although highly centralized have an advantage over large firms at the initiation stage of the innovation process since they are less formalized and more open to informal communications. They postulated that the negative effects of a high centralization at the initiation process in small firms were outweighted by the personality of top managers or entrepreneur who due to specialization and favourable attitude towards innovations was acting as a "promotor of innovations by know-how" (p.438). Furthermore, a powerful executive due to centralization of authority was able to act as a "promotor by power" (p.438) thus facilitating innovations during the stage of adoption and implementation. In addition they attributed the problems faced by small firms during the evaluation and adoption process to the lack of systematic judging of proposals which in turn was a result of the lack of task standardization and formalization. Therefore they recommended a higher level of task standardization and formalization during the process of idea evaluation and adoption.

Khan and Manopichetwattana (1989) studied the characteristics of 50 Texas small manufacturing firms producing different product groups. By using cluster analysis they identified 5 groups of firms of which 2 were innovative ("the young turks" & " the blue chips") and 3 were non-innovative ("the silver spoons", "the striving stoics" and "the kismets"). The study by Khan and Manopichetwattana is very important since typologies of innovative firms are constructed based on a large and diverse set of independent variables. In addition it represents a depart from the existed dichotomy (innovative, non-innovative) since it identifies different modes of innovative and non-innovative firms based on different strengths and weaknesses in various aspects and different situational conditions. They concluded that within the innovative group the "Young Turks" were firms comparatively younger, highly proactive, research oriented and risk takers while the "Blue Chips" were characterized by management quality. Regarding the non-innovative firms the "Silver Spoons" were firms opposite to "Blue Chips" who survived mainly due to past success; the "Striving Stoics" lacked entrepreneurial strength and the "Kismets" were managed by executives tending to an external locus of control and a strong attitude in favour of luck.

4.3. CONCLUSIONS & IMPLICATIONS FOR PRESENT STUDY

This chapter has reviewed literature relevant to the influential role of economic and organizational/ managerial factors upon the adoption and diffusion of innovations.

With regard to economic factors the arguments presented above raise important methodological implications for the present study. As it was shown, economic factors are amenable to different interpretations which sometimes contradict each other. Therefore, instead of dealing with figures of published data only, the prospective researcher must undertake a qualitative inquiry of the economic considerations underlying the decision of a firm to adopt or reject an innovation. This is expected to add strength to any identified statistical relationships. Moreover, it can reveal interpretations of economic factors by management or factors that have not been included in one's own conceptual framework. As such, it was decided to exclude from the present study the investigation of economic indicators of the firms upon their adoption response towards innovations. Instead, it was believed that economic considerations would be projected by means of investigating in-depth the reasons given by firms with regard to their adoption or rejection response. In this endeavour the author also was expected to be assisted by the fact that in the present study factors internal and external to the firms are considered which ultimately, are the underlying causes of firms' performances.

Regarding managerial factors it is apparent that a firm's receptivity to innovations is positively related with the quality of its management and it is influenced by its top management's characteristics.

However, regarding organizational factors, the assertion that organismic structural modes are more conducive to innovations than mechanistic ones has been debated to a great extent in the literature.

Furthermore, recent studies have produced evidence in favor of the constriction of authority perspective which obviously, is opposite to the contingency theory of Burns & Stalker and Lawrence & Lorsch. Clearly, this evidence calls for a reappraisal of many organizational factors and their postulated influence on the adoption and diffusion of innovations.

To this end, Holbek (1988) has postulated, among others, the need for research towards a more systematic mapping of content in the concepts 'termed organic and mechanistic'. Research on the adoption of innovations makes the underlying assumption that an organization must alter or shift to organizational forms that are favourable to the specific demands as they appear during the adoption process, so as to minimize the negative effects of one structural form, thus capitalising on the positive effects of the other. However, Kimberly (1981) states that the innovation issue involves more than questions of organic versus mechanistic structures. Moreover as Hage's (1965) conceptual framework indicates, the structural mode of a firm serves a number of organizational means e.g. adaptiveness, productivity, efficiency and job satisfaction. According to his framework, organizational characteristics in favor of adaptiveness can impede or deteriorate productivity and efficiency, a fact which only in part (stages in the adoption process) has been taken into account by innovation researchers. However, losses in productivity and efficiency can undermine the overall performance of a firm thus diminishing its financial means which have been found influencing the adoption of innovations.

Besides, research in small firms has indicated that the negative effects of a predominant mechanistic structure are relaxed or neutralised by the innovative personality of top managers. This indicates that the influence upon adoption of the organizational structural forms employed is contingent upon other characteristics of the organization. To this end one can list characteristics internal and external to organizations. As internal can be regarded, inter alia, the attitude towards innovations of the people employed by the firm (both managers and workers), their cosmopolitanism and the overall procedures employed by the firm for the gathering of technical information. Obviously these characteristics are managerial and their relevance in the adoption process has been documented above.

Armed with the above insights, the present study encounters both organizational and managerial characteristics of the firm and assesses their influences upon the adoption behaviour of firms explicitly. As it will be seen later in chapter 6 organizational and managerial characteristics of the firm are incorporated into the conceptual framework of this study indicating the behavioural dimension of the firm's innovativeness. These characteristics include: the degree of formalization and centralization, existence of an R&D department and collaboration with research institutes, existence of strategic planning, the frequency of proposals for the introduction of new products the recruitment programme of the firm, the degree to which the firm encourages its employees to participate in scientific events and the attitude of the firm's managers and employees towards innovation[17].

Moreover, as it will be seen in chapter 6 the technological dimension of a firm's innovativeness is captured by factors related to the production process and the products of the firm. These factors include: the capacity utilization rate of the firm, the firm's past record in new technology investments, the status of the technological base of the firm, the percentage of firm's sales generated by new products and the dependence of the firm upon few products and customers[18].

As it was shown above, many of these factors are within the interest of strategists. However, in the present context they are used for reflecting the technological diversities among firms and not for accounting the influence of strategic typologies upon the adoption behaviour of firms. The latter is out of the objectives and the reach of the present study since it was felt that, owing to the complexity and the lack of research in the field of strategy as related to the adoption of innovation, further attention to strategy and strategic typologies would had diverted the direction of this study. The author deems that the linkage of strategy with adoption of innovations is so complex that it can be examined only by a much more focused research to strategy than by the present one.

To conclude, this chapter has provided a selective review of the influence upon adoption response of economic and organization/managerial factors and has delineated the major issues to be considered in the present study. These factors represent mainly factors internal to the firm. The next chapter will encounter factors external to the firm and will investigate their influence upon the firm's adoption response towards innovations.

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[17] See chapter 7, section 7.6 for the relevant discussion.

[18] See chapter 7, section 7.5 for the relevant discussion.

CHAPTER FIVE

THE INFLUENCE OF THE EXTERNAL ENVIRONMENT

5.1. INTRODUCTION

In this chapter the organization's external environment and its influence on the adoption of innovations will be investigated.

Hutt & Speh (1987) postulated that environmental factors define the boundaries within which industrial buyers and sellers interact and Webster & Wind (1972) suggested that these factors influence the buying process through the provision of information, or by raising constraints and stimulating opportunities.

According to Zaltman et al. (1973) "the external environment consists of those relevant physical and social factors outside the boundaries of the organization or specific decision unit that are taken directly into consideration in the decision-making behavior of individuals in that system" (p.114). In addition Webster and Wind (1972) postulated that environmental factors consist of physical, technological, economic, political, legal and cultural factors. A different conceptualization of the external environment's components is offered by Duncan (1972) in the following table 5.1.

Table 5.1: Components of the external environment

CUSTOMER COMPONENT
SUPPLIERS COMPONENT
COMPETITORS COMPONENT
SOCIO-POLITICAL COMPONENT
TECHNOLOGICAL COMPONENT

Source: Duncan (1972)

Duncans's seminal work on the components of the external environment is regarded as one of the most complete works on the issue (Zaltman et al. 1973). However no single study has taken into account all the components of the external environment as suggested by Duncan.

This lack of attention to environmental factors has been noticed by Rothwell (1977) who stated that in most innovation studies "by and large exogenous factors such as the role of government policy, or legislation, the role of competition, and the effect of the general economic environment figure hardly at all" (p.203).

This chapter, therefore, will attempt a selective review of the work of many researchers by classifying them in accordance with Duncan's conceptual framework of the external environment's components. However, the supplier component has been already examined in chapter 2 and therefore, will not be covered here.

5.2. COMPETITORS COMPONENT

5.2.1. COMPETITIVE INTENSITY

Competitive intensity or rivalry in the industry has been researched mainly in studies that deal with innovation development and not with the adoption or diffusion of innovations.

As such, many different views have been appeared in the literature. According to some authors rivalry in the industry creates competitive pressures to firms which are forced to innovate mainly due to the following reasons:

a) to sustain and increase their position and market share,

b) to respond to competitors' actions, and

c) to create barriers to entry for new firms.(Freeman 1979, Grabowski & Baxter 1973, Levin 1978)

However Kamien and Schwartz (1976) found that "more intense rivalry characterised by an earlier expected date of rival introduction, will first elicit a greater R&D investment by the expected profit-maximising firm but will eventually cause the optimal intensity of innovative activity to decline". In other words, there is generally some intermediate degree of rivalry at which a firm's pursuit of R&D is most vigorous (Levin 1978).

With respect to the adoption of innovations, O'Neal et al.(1973) studied the relationship between competitive intensity in industry and number of innovations adopted in this industry. To measure industry competitiveness they used:- a) the industry's inventory levels, market share concentration and number of price changes. Their results were incoclusive. They postulated that there exist a conflict in the relationship between industry competitiveness and innovation response. Specifically, when there is a large number of firms sharing the industry's volume the need for innovation adoption by each firm exists in order to enhance its position, but the resources to each firm are limited. Similarly, when there exist high concentration of firms in an industry, the large firms possess the necessary resources to pursue innovations but they lack the need. O'Neal et al. concluded that the greatest degree of innovation would be expected to come from an industry having only "moderate concentration and thus more balanced firm size" (p.246).

Romeo (1975,1977), found that competitive pressures in an industry seem to lead, other things being equal, to high rates of diffusion of numerically controlled manufacturing technology. He measured competitiveness in industry using two measures:- the number of firms, which was positively related, and the variance of the size distribution of firms, which was negatively related to adoption and diffusion.

Similarly, Globerman (1975) concluded that competitive pressures which have been created in the U.S. carpet industry from the use of the tufting process from newly established small firms have forced the already established and large firms to adopt the method. In addition, Kimberly and Evanisko (1981) found that the adoption of either technological or administrative innovations by hospital was positively related to the competition faced by each hospital.

In contrast with the above, Mamer et al. (1987), postulated that the manager who is faced with a decision whether or not to adopt an innovation, whose economic value is not certain, elects to decrease this uncertainty by gathering information, but the uncertainty regarding the actions of competitors cannot be reduced. In this respect, they found that the potential for competition from substitute technologies decreases the probability that the firm will adopt an innovation. According to them substitute competition induces the firm to use a less optimistic (more conservative) decision strategy.

Finally, Robertson and Gatignon (1986) suggested that the relationship between competitive intensity and innovation receptivity is curvilinear. According to them "reasonable levels of competition encourage the acceptance of innovation but beyond some point the financial resources of the industry are depleted and the acceptance of innovations is stifled" (p.7). In a recent study of 125 firms from different industrial sectors (Gatignon & Robertson 1989) they sought the relationship between adoption of laptop computers and industry concentration as well as between adoption and competitive price intensity. They found that adoption of laptop computers was positively related with a high concentration level in the industry and a low intensity of competition in price.

5.2.2. NEW FIRMS ENTRY RATE OR BARRIERS TO ENTRY

In the previous discussion it was mentioned that firms innovate, among other reasons, in order to create barriers to entry for new firms thus guarding their own position and market share.

Levin (1978) and Porter (1985) argued that over time investment in technological innovation is an important mechanism for reproducing barriers to entry. However these barriers are vulnerable to new entrants who acquire knowledge of existing technology without cost but with a lag. According to Gatignon et al. (1989) the new entrant "wakes up" the industry and "heightens competition which forces a firm to re-examine its practices and correct errors..."

Evidence in support of the above is provided by Globerman (1975) who found that the diffusion of the tufting method in the Canadian carpet industry was much slower than in the US carpet industry due to severe barriers to entry in the industry imposed by the already established firms.

5.3. TECHNOLOGICAL COMPONENT

Bright (1964) observed that in industries which are characterized by frequent technical changes, firms will tend to be more willing to accept innovations. Supporting evidence to the above relationship is provided by O'Neal et al. (1973) who by comparing two industries found that the technical environment of the industry has a positive influence on the receptivity of organizations to innovations. On the basis of their findings they postulated that "the dynamic industry with frequent technical change would tend to create an atmosphere conducive to even greater change" (p.246) thus promoting the adoption of innovations.

Similarly, Bundgaard-Nielsen and Fiehn (1974) found in the US petroleum refining industry that a large number of firms which were among the early adoptors of the new catalytic reforming process were facing strong strategic pressures due to the combination of new developments in the industry and the use of old techniques by them. However, Antonelli (1989) found that firms are more likely to delay the adoption of an innovation the more dynamic they perceive the technological environment to be. This tendency is due to the greater awareness of incremental technological change and the consequent higher option value associated with the irreversibility of investment.

5.4. CUSTOMER COMPONENT

There exists ample empirical evidence in support of the decisive role of customers in the innovation process. Their role has been postulated by Langrish et al. (1972) and has been substantiated by means of the empirical findings of Hippel (1977a,1977b,1978) and Foxall (1984,1988,1989).

Langrish et al. (1972) introduced the concept of the 'demand pull' as opposite to the 'technology push' concept. Whereas the 'technology push' model suggests that technological advancement is the main stimulus for innovations, Langrish et al. postulated that market needs and demand, as they are expressed by customers or identified by the management of the firm, provide the incentive for a firm to innovate. Utterback (1974) supported their view and by reviewing eight empirical studies found that the largest proportion of sources stimulating innovations were market, mission and production needs. Recently, Ettlie and Vellenga (1979) found that 53% of the innovations studied were stimulated by market demand, 35.2% by operating cost and efficiency and only 4% by technical developments.

Furthermore, Rothwell et al. (1974) found in their SAPPHO project that the majority of the successful innovations in their sample were initiated by market demand. However Cooper (1979) found no such difference between innovations that have been successful and innovations that have failed. Others have suggested the need for simultaneous existence of demand-pull and technology-push conditions for the innovation's success. On the same lines Goldhar et al. (1976) identified in their study different conditions that stimulated innovations. They distinguished these conditions into economic and technological information and assessed their relative importance which is illustrated in the following table 5.2

In addition Hippel's (1977b,1978) empirical findings documented well the decisive role of customers in the innovation process by suggesting ideas for innovations (lead users) and by participating in the development process of the innovation (Customer Active Paradigm). On the same lines, Foxall (1988) found that customers' involvement in the innovation process can take different modes which can range from a relative passive customers' role to a very active role where all the stages of development, including initiation and commercialization, are performed by them.

The role of customers has also been taken into account by researchers who sought the influence of a heterogeneous industrial environment in the adoption of innovations. According to Khandwalla (1972) environmental heterogeneity represents conditions of diversity of customers or segments to be served by a firm each of which requires different kinds of handling.

Table 5.2 : Conditions that stimulate innovations

	% reported as greatest value
General market need (E)	24
A specific client's need (E)	12
A different innovation (T)	2
Generally available technical data (T)	7
Specific new technical information (T)	14
A production requirement (T)	2
Firm's need to offer a competitive product (E)	1
Need to reduce product's selling price (E)	0
Need to reduce production costs (E)	1
Firm's need for a new product (E)	4
Recognition of a new technical possibility (T)	23
Recognition of a new economic opportunity (E)	7

Where: (E) economic information and (T) technological info.
Source: Goldhar et al. (1976)

Empirical evidence indicates that environmental heterogeneity promotes the adoption of innovations. The underlying argument in favour of such a relationship is that the diversity of customers of a firm results into a diversity of interests imposed by them on the firm which in turn is called to deal with them by adopting innovations (Balbridge & Burnham 1975). In different terms, Khandwalla (1972) suggested that environmental heterogeneity creates organisational structures closer to organic conditions which in turn are conducive to innovations. He developed the term of 'perceived environmental uncertainty' and postulated that unless a firm feels that its different customers or segments need different handling the concept of heterogeneity is irrelevant.

Recently, Lefebvre et al. (1991) studied the technology adoption decision in small manufacturing firms which were distinguished into more innovative and less innovative firms. Among other they concluded that the "most important influence on the adoption decision in more innovative companies is that of clients and the impact of the new technology on the image of the company" (p.247). Furthermore they suggested that more innovative firms as compared to less innovative firms have an outward orientation which is dominated by clients and suppliers.

In conclusion, the prevailing view in the literature is that the character of the client population served determines the demand for services, the scope of activities and the human resources to be utilized by an organization (Balbridge & Burnham 1975).

5.5. SOCIO-POLITICAL COMPONENT

An eminent part of the environment's socio-political component is the role of government in the industry.

Abernathy and Chakravarthy (1979) stated that government policy sets the context for industrial development. In addition Pavitt and Walker (1976) attributed the need for government policy and intervention to imperfections which arise in the market system and impede innovations.

Allen et al. (1978) postulated that innovations are influenced by environmental factors such as the general state of knowledge in industry, market conditions and resource availability. These conditions in turn are influenced "intentionally or unintentionally, directly or indirectly by government policies and activities" (p.124). Allen et al. produced a classification scheme for 12 general categories of governmental policies and activities. They found that, although a large number of companies in their sample made use of governmental incentives, they perceived their influence as negative rather than positive in the innovation project. However, it was found that government regulations such as environmental and product safety controls and requirements were positive to innovations since they were forcing innovations to occur in directions otherwise neglected by firms.

Bollinger et al. (1983) made an extensive literature review of the governmental policies and actions which have been found to promote innovations. They concluded that governments can influence the innovative activity of firms through 8 general mechanisms, namely: purchases or procurements from private sector enterprises, subsidies, tax incentives, scientific and technological infrastructure, regulations, venture capital, patent system and economic climate. However, they reported that none of these mechanisms have produced consistently satisfactory conditions for the promotion of innovations. Therefore they postulated that "governments encouragement may be a necessary but not sufficient condition" (p.13) for the promotion of innovations.

Rubenstein et al. (1977) in their international study examined the awareness, relevance and effect of government incentives programmes upon the R&D/Innovation process. Data from a relative large number of firms classified as either of high or low technology indicated similarities but also many differences between high and low technology firms as well as among countries (U.K., France, West Germany and Japan). With the exception of firms in the U.K., the high technology firms in other countries were more aware of government incentives programmes than low technology firms, and were perceiving more relevance and effect of these incentives in their R&D/innovation projects. However, with the exception of Japan, the overall perception as expressed by firms was that the government was rather an obstacle than a supporter of innovations. Interestingly, Japanese firms had a positive opinion regarding governmental attitude towards innovations.

Another international study conducted by Parkinson and Avlonitis (1986) studied, inter alia, the role of government support in the adoption of new flexible manufacturing technology in U.K. and West Germany. Their findings coincide to a large extent with those of Rubenstein et al. (1977), with awareness being greater in West Germany than the U.K., a general view of irrelevancy of government support in the decision to adopt new manufacturing technology, a negative perception towards government's understanding of industrial problems, and a general unwillingness to use governmental incentives due to the bureaucracy involved with the paper work during the application procedures. However, Parkinson and Avlonitis postulated that in certain cases in the U.K. governmental support was a very important enabling condition for firms adopting flexible manufacturing systems. They found that some companies financed with governmental grants 50% of the consultancy work on FMS.

5.6. COMMUNICATION IN INDUSTRY

The role of communication is central in Rogers (1983) definition of innovation diffusion. He defined communication as the process "by which participants create and share information with one another in order to reach a mutual understanding" (p.313).

McCardle (1985) developed a model for innovation adoption or rejection as a function of two parameters: innovation's estimated profitability and amount of information acquired by the firm. He postulated that it is optimal for a firm to gather information up to the point were the profitability of the innovation exceeds or is placed below the required profitability imposed by the firm. In the first instance the firm adopts the innovation whereas in the second it rejects it.

From another perspective, Carter and Williams (1958) found that 5 of the characteristics of technically progressive firms were related to communication.

Rogers developed the concept of opinion leadership and change agent in the diffusion process on the basis of findings of many researchers that individual buyers are influenced by other individuals. Furthermore, Mancusco (1969) suggested that opinion leaders can foster the new product introduction and therefore it is important for any producer to seek their assistance when introducing new products. However, Webster (1971) postulated the non-existence of informal communication (opinion leadership and word-of-mouth) in industrial markets. He argued that buyers in industrial markets rely more heavily upon the information provided by the selling firm as opposite to consumer markets where the importance of word-of-mouth communication has been advanced by Engel et al. (1969).

In contrast with Webster, Robertson (1967) postulated the existence of a two-step communication flow of information where opinion leaders enhance the innovation message to the potential adoptors. In addition, he argued in favour of the existence of a social system among adopters, where participants communicate with each other mainly in order to reduce the perceived risk involved with the decision to adopt a product, for which they have limited experience and information.

Empirical support to Robertson's suggestions is provided by Martilla (1971) who studied the buying process in a large number of paper converting firms. He found that individuals participating in the buying process were using a whole array of information sources during different stages of the buying process.

Martilla's conclusions received further empirical support by the work of Czepiel (1974) who studied the diffusion process of continuous casting in 18 steel manufacturing firms. Czepiel identified dense informal word-of-mouth communication networks among firms in the industry and therefore suggested that the diffusion process should be studied as a communication process. He found that these informal contacts among individuals were initiated by friendship, colleagues relationships and by suppliers. Czepiel suggested that this frequent communication in the steel industry may be a function of its maturity and the lack of secretiveness due to commonality of technology, but is less likely in other industries where the type of production technology possessed may constitute a significant competitive advantage for the firm.

Furthermore, Moriarty and Speckman (1984) postulated that industrial marketers can influence the buyer's decision through the source, timing and quality of information provided. In addition, Goldhar et al. (1976) suggested that one way to stimulate or control the direction and rate of technological innovation is by influencing the organizational and informational environment of the innovating firm. They suggested that the following characteristics of the informational environment are conducive to innovations:- a) Easy access to information by individuals; b) Free flow of information both in and out of the organization; c) mobility and interpersonal contacts.

Recently, Robertson and Gatignon (1986) hypothesized that signal frequency and clarity in the industry, are positively related to the adoption and diffusion of innovations. Gatignon and Robertson (1989) tested empirically their hypothesis regarding the relationship between signal frequency & clarity (communication openness) with the adoption of laptop computers. Their results however, disconfirmed their hypothesis for a positive relationship.

5.7. CONCLUSIONS & IMPLICATIONS FOR PRESENT STUDY

From the foregoing discussion it is apparent that a large number of researchers have attempted to investigate the influence of environmental factors upon the development, adoption and diffusion of innovations.

However, it is also apparent that no single study has attempted to investigate all the components of the external environment. This can be attributed either to the different theoretical backgrounds and points of interest of each researcher or to the fact that not all the components of a firm's external environment are relevant to a particular decision making situation such as the adoption of an innovation. To this end Zaltman et al. (1973) based on the work of McWhinney (1968) substantiated the importance of the "domain problem" since "the domain indicates what part of the environment the organization must consider relevant in its decision making" (p.116). However they added that "the question, becomes, what is the important domain in the innovation process?" (p.116). To this end one may assume that the environmental factors mentioned above have been examined within situations where they were relevant indeed. However, the studies reviewed above provide no supportive evidence to that which, if indeed has not been taken into account, can methodologically undermine the validity of many of the above results.

Since it is difficult to determine in advance which components of the external environment are more relevant than others in specific situations, a viable solution for future research can be an investigation of all the components of the external environment under situations involving adoption of innovations. This approach will identify the most relevant components by itself and eventually, will guide any prospective researcher, although one must admit that changes in the environment, the organization and the situation in question do change the relevance or importance of the environment's components. Having said that, such an approach is employed in the present study and elements of all the components of the external environment are taken into account.

Furthermore it is evident from the foregoing discussion that the influence of environmental factors upon the adoption of innovations has been interpreted in the literature in many different ways. One states that the environment "create a situation of stress or pressure to which the adoption unit must respond if it is to remain in a relationship of 'dynamic equilibrium' with the environment" (Zaltman et al. 1973, p.110) and this eventually fosters the adoption of innovations. Another interpretation states that environmental conditions are capable of diminishing the financial resources of industries and firms which in turn become an obstacle and hinders the adoption of innovation. The latter is evident in the case of the industries' competitive intensity in price (Gatignon & Robertson 1989). Similarly the environment can impede innovation through its "external resistance to change" when its norms do not favor the changes implied by the innovation (Zaltman et al. 1973, Rogers 1983). Finally, an alternative states that the environment creates not only constraints or threats but also opportunities or incentives (Webster & Wind 1972) that foster the adoption of appropriate innovations by firms which are distinguished from others on the basis of the degree of asymmetry among them (unit cost, good produced etc.), technological diversity (a result of firm-specific histories of technological accumulation) and behavioural diversity (a result of firm's managerial practices and strategy towards innovations) (Dosi 1988).

These diverse interpretations can be regarded as an indicator of the yet limited theoretical understanding of the environment's influence upon innovations. To this end the investigation of the following issues is expected to assist any attempt towards a better understanding of the influence upon adoption of the different components of firms' external environment.

1. Regarding the competitors component and competitive intensity, the majority of researches have investigated only how competition in price and concentration in the industry affect innovations. However, as early as 1942 Schumpeter postulated that it is the combined absence of price competition and presence of nonprice competition that stimulates innovations. He suggested that "...in capitalist reality as distinguished from its textbook picture, it is not that kind of competition (price) which counts but the competition from the new commodity, the new technology, the new source of supply...". It is therefore essential to investigate not only price competition, but also other kinds of competition, such as competition in product characteristics (quality, features) and competition in promotional activities and distribution/services. Moreover, since the relative influence of environmental factors depends, among other things, upon the individual's own perception of them (Duncan 1972) one must take into account not only the intensity of the above types of competition for a firm but in addition the relative perceived importance of each type for the firm itself.

2. Regarding the technological component, the prevailing view in the literature is that firms in industries with more frequent technical changes will tend to be more willing in accepting innovations (O'Neal et al. 1973).

However, while such an assertion can partly explain differences in the innovative behavior among firms from different industries it cannot highlight the differences among firms which belong to the same industry and eventually face the same degree of technical change. To this end, one can argue that even within the same industry different firms have different perceptions of the degree of the technical change since such perceptions depend upon the ability of the firm to scan and process information from the environment (Zaltman et al. 1973). Furthermore interfirm technological and behavioral diversity (Dosi 1988) (indicative of the firms' chosen path of development and behavior in the past) differentiate firms in their ability to absorb new technologies by either erecting obstacles or by offering opportunities.

Therefore, the influence of the technological component upon the adoption of innovations can be better assessed through the simultaneous investigation of the firms' perceptions of technical change and their past performance in sustaining an equilibrium or close distance between the technological status of their production factors, and the technical change of the environment.

3. Regarding the customers components, the empirical evidence presented above suggest that market demands expressed by customers or identified by the management of the firm, provide incentives for the firm to innovate by producing or adopting innovations. However, the customers base of a firm as well as the markets in which it operates depend partly on the firms strategic decisions. To this end, a firm which is facing technological demands from its customers instead of adopting innovations, might chose to serve less demanding customers or shift to less demanding markets. Therefore, in order to answer the question whether a firm will adopt an innovation or not, one must consider both the character of the client population and the character of the serving firm. In other words, it is proposed that research efforts should focus into the combination between a demanding and receptive customer base or market and a receptive serving firm.

All the issues above substantiate the need for more research on specific directions which have been taken into account during the design of the present study and the development of its hypotheses[19].

Having examined the influence upon the adoption response of firms of factors related to their external environment, the next chapter will present the conceptual framework and the methodology of the present study.

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[19] See Chapter 6 and Chapter 7, Section 4 for the investigation of the above issues.

CHAPTER SIX
CONCEPTUAL FRAMEWORK AND RESEARCH METHODOLOGY

6.1. CONCEPTUAL FRAMEWORK

6.1.1. INTRODUCTION

In the preceding chapters a series of issues associated with the industrial adoption of technological innovation were reviewed. These issues were based upon empirical evidence and theoretical insights from many salient fields of inquiry which covered marketing (new product development, success and failure of new products, adoption and diffusion of innovation), sociology, industrial economics and industrial buyer behaviour. It became evident from this literature review that the adoption of innovation is a complex phenomenon involving a host of variables which, through their interaction, explain the propensity of a firm to adopt an innovation.

Moreover, this literature review revealed an array of researchers and articles approaching innovation from a variety of levels and from a variety of perspectives and disciplines. However, as it was noticed, some aspects of innovation adoption have been highlighted to a great extent, whilst some others are still surrounded with contradictions and controversies and others, are virtually in darkness. Since many of these aspects have already been identified in the previous chapters of this thesis, the first part of the present chapter will attempt to construct a conceptual framework, which is expected to assist the present efforts in shedding some light to the above.

This attempt will start with a critical assessment of previous models by taking into account the new developments in the study of innovations. This will be followed by a presentation of the conceptual framework and the hypotheses derived from it. The second part of this chapter will illustrate the methodology followed for the investigation of the validity of the research hypotheses.

6.1.2. A CRITICAL ASSESSMENT OF PAST MODELS

As was stated previously, researchers have approached innovation at different levels and from different perspectives and disciplines. This has resulted in the development of many partial frameworks or models dedicated to serve the specific objectives of the individual researcher. As such, they inquire into only certain aspects of the adoption of innovation and their contribution is limited to their own areas. However, when considered within the context of an overall framework or comprehensive model, they are capable of identifying and integrating meaningful areas of research (Hill & Hillier 1977). Relatively few holistic models have been proposed in the study of adoption of innovation, and most of them are largely based or derived from the organizational buying behaviour discipline. The latter can be attributed to the widely acclaimed view that the adoption process is nothing more than a special case of the industrial-buying process for a new product (Hill et al. 1977, Baker 1975a, Foxall 1984a).

Although this is not a central theme in this thesis, one is compelled to disagree in part with the above perspective, as well as with Foxall's aphorism which states that "further obfuscation has arisen in marketing as a result of an artificial distinction between models of 'general buyer behaviour' and those which purport to make peculiar reference to innovative buying. The result is that models which are essentially similar in scope and range are assigned somewhat arbitrarily to one or other of these categories as though they applied to different orders of reality or levels of analysis" (Foxall 1984a, p.96).

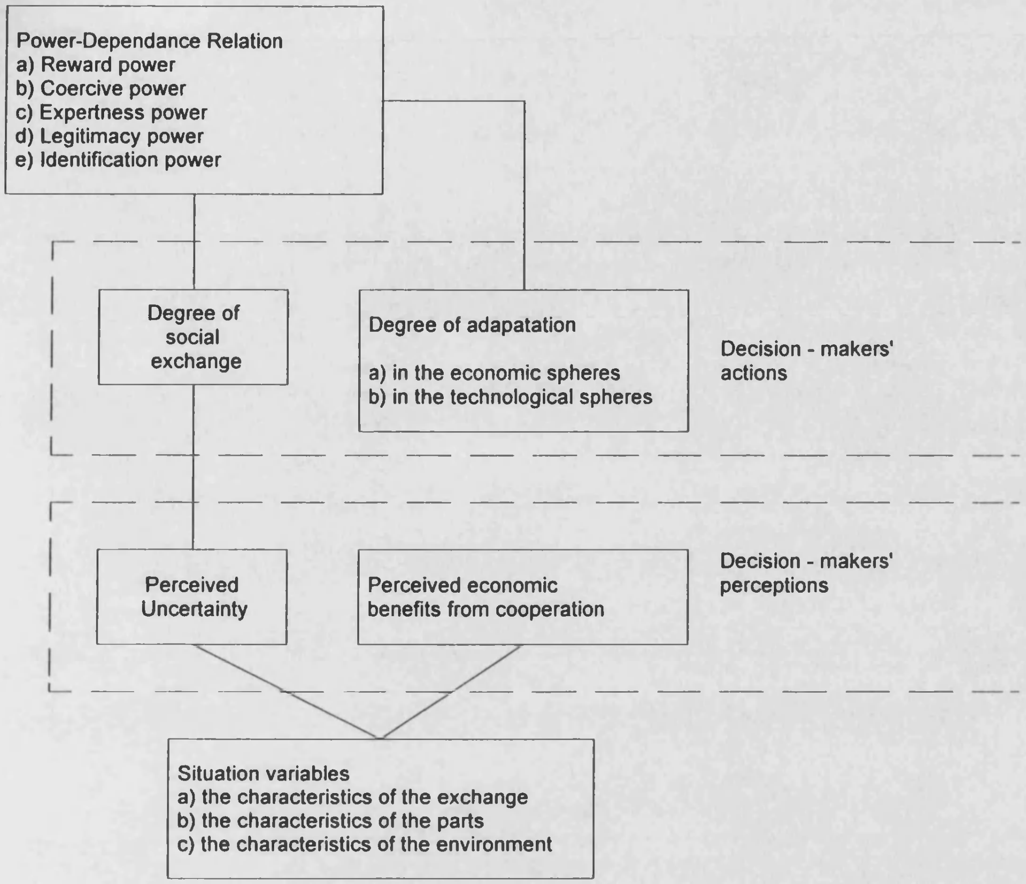
Contrary to the above, the author believes that while the similarities between the two processes are obvious, the inability of researchers to find differences between the two is rooted in the fact that both have been perceived as processes which start only after the 'physical' production of the product in question. However, Foxall (1984b, 1989), as well as Hippel (1977a, 1977b, 1978, 1986), have substantiated the case where innovative adoptors acquire a potentially feasible product or technology by participating in its actual development. In this case, although the product exists only in the sphere of fiction, (i.e. an idea which has not yet been physically produced), the adoption process has already started and its final outcome will be largely determined by the outcome of the development process. Clearly this case, which is exclusively applicable to innovation, implies the existence of 'different orders of reality and certainly different levels of analysis'.

Having said that, we can now turn our attention back to comprehensive models of industrial adoption of innovation (or models of industrial buying). According to Moriarty and Galper (1978), their value is "in demonstrating how the parts of the puzzle are put together by different people" (p.18). Moreover, according to the same authors, these models are capable of illustrating the evolutionary process of the theory in a specific field. To this end the models developed by Rogers (1983), Ozanne and Churchill (1971), Webster and Wind (1972), Sheth (1973), Baker (1975a), among others, can be cited as representative of the theoretical insights gained in the field of adoption of innovation and industrial buying behaviour. These models have established well, among other things, the concepts of the buying center, different stages and decisions in the adoption (buying) process, different participants, and the influence of adoption (buying) determinants such as information sources, environmental characteristics, organizational, individual and interpersonal factors, product specific factors and situational factors.

Despite the unquestionable value of the above models, further empirical findings revealed many deficiencies and postulated the need for research in three directions which are not captured by previous models. These include the relationship developed between the buyer and seller, the role of suppliers and their activities in the adoption process, and the role of a firm's past history in defining its capabilities and receptiveness to innovation.

Regarding the first direction (existence of a relationship) Baker (1975b) argued that "with rare exceptions, innovations are introduced by organizations which already have an existing product line and existing customers-in other words, there already exists a relationship between seller and buyer and we cannot afford to ignore this in investigating the reaction of prospective adopters to an innovation". On the same lines, Hakanson and Ostberg (1975) concentrated on the purchase transaction and conceptualised it as "an interaction system between two active counterparts rather than merely a relationship between one active component and a passive market" (p.114). To this end they introduced an interaction model which is depicted in the following figure 6.1.

Figure 6.1.: The interaction model (Hakanson & Osberg 1975)



However, from what is known by the author, this model has not been explicitly used in the adoption of innovation research tradition. Instead its use has been restricted to the investigation of the relationships among buyers and sellers in general purchasing situations involving usually international industrial markets and dealing with the choice of a supplier.

Nevertheless, use of the ideas underlying the interaction approach has produced, implicitly, many useful insights into industrial buying behaviour and the adoption of innovation. To this end, as it was shown in chapter 2, relationships developed between parties result to common investments which in turn, are acting as 'inertia' mechanisms impending the shift from one supplier to another (Cunningham & White 1973), and by implication the acceptance of an innovative product offered by a firm not previously participating in the relationship. Similarly, Ford (1984) produced empirical evidence in support of the idea that buyers' perceptions of the technical and commercial skills of suppliers are associated with their perceived adaptability, distance, commitment and conflict with the supplier, which clearly are characteristics of the relationship between sellers and prospective buyers.

Regarding the second direction (the role of supplier and its activities), Choffray and Lillien (1978) noticed that "The most important consideration ignored in the published literature is managerial use. Most important, these models (of buyer behaviour) give little attention to the role played by controllable marketing variables on industrial market response" (p.21). Therefore, they developed a model (figure 6.2) which included the influence of the supply side under the heading controllable variables to indicate the marketing support for the product and its design characteristics. Similarly, as it was shown in Chapter 2, Gatignon and Robertson (1989) acknowledged in their model, the role of suppliers as well as the competitive forces in the industries of both buyers and suppliers (figure 6.3). An extensive evaluation and criticism of this model has been already presented in chapter 2.

Figure 6.2.: Response model structure (Choffray and Lillien 1978)

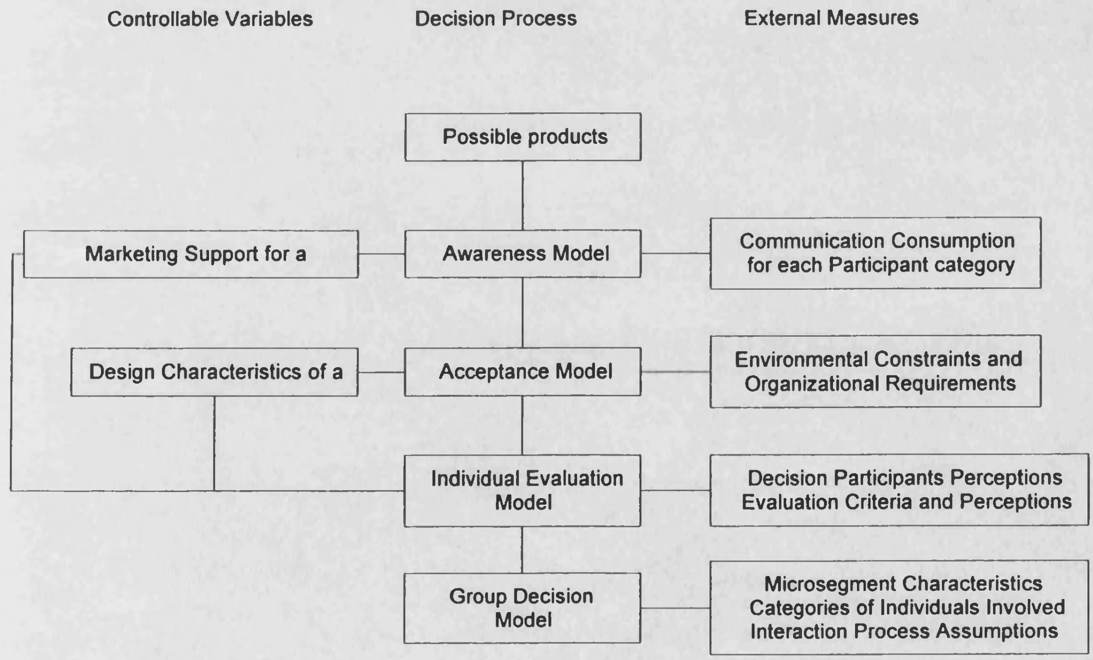
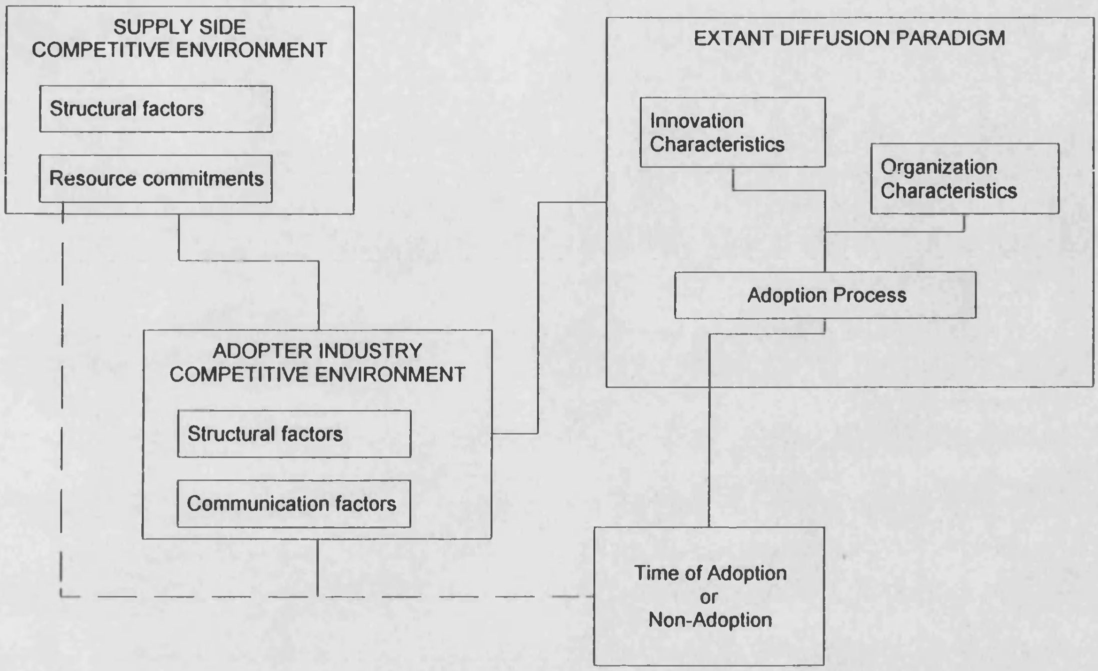


Figure 6.3.: A competitive behaviour paradigm for technology diffusion among organizations (Robertson & Gatignon 1986)



Finally, developments in the industrial economics research tradition have enabled the conceptualization of the search, development and adoption of innovation as "the outcome of the interaction between a) capabilities and stimuli generated within each firm and within industries, and b) broader causes external to the individual industries" (Dosi 1988, p.1121). Insights gained in this field have been mainly used for the identification of the locus of innovative technological activity (Teece 1986, Williamson 1981, Hippel 1982) and the explanation of differences in technological performance among industrial sectors and among countries (Pavitt 1984, Freeman 1982, Mansfield 1968).

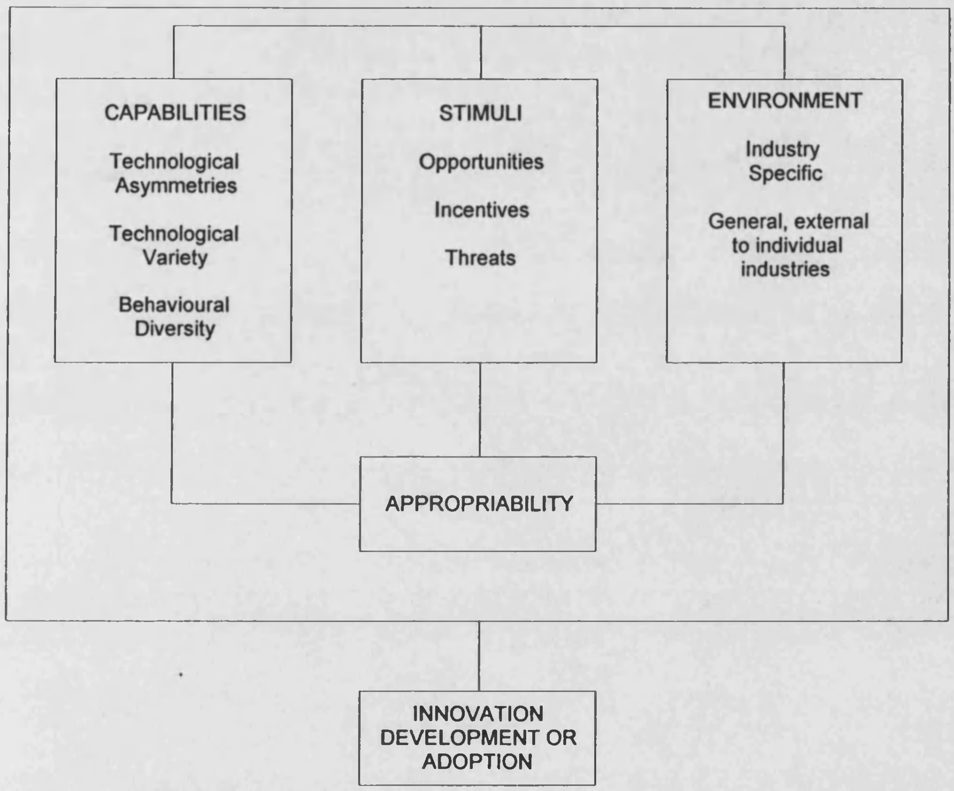
Recently, Dosi (1988) attempted to integrate a large number of empirical findings in this field with the aim to identify, among other things, the factors that account for the observed intrasectoral differences in the rates of innovation. Dosi's work offers many new insights into the study of innovation. More specifically, Dosi suggests that innovations "entail ceteris paribus an *asymmetry-creating effect*, which allows some firm(s) to enjoy some improvement in its competitive position" (p.1159). These asymmetries have a technological and a behavioural component and, as such, they are the result of different degrees and histories of technological accumulation, and different managerial strategies respectively.

Moreover, Dosi maintains that "technological asymmetry and variety, as well as, behavioural diversity among firms are the *outcome and the driving force* of technological and organizational change...in that they underlie the competitive incentive (for the 'winners') and the competitive threat (for the 'losers') to innovate/ imitate products, processes and organizational arrangements" (p.1158). He notes that "asymmetries in the capabilities of firms impose limits" on the degree to which laggard firms can exploit innovation. In contrast "firms that achieve higher levels of innovativeness (competitiveness) increase also their probability of maintaining or increasing their levels of competitiveness (innovativeness)" (p.1161). It is essential to explain here that Dosi perceives the latter capability of already innovative firms in connection with the appropriability of new technological changes and other environmental and market factors. The following figure 6.4. illustrates in a very comprehensive way the results of Dosi's integration and interpretation of past empirical findings produced mainly in the industrial economics research tradition of innovation.

Clearly, Dosi's ideas resemble the ones developed by scholars in the innovation's adoption and diffusion domain and industrial buying behaviour where, the characteristics of individuals and the organization influence the outcome of the adoption or buying process. However, Dosi attempts a more dynamic conceptualization of the firm as a whole, in its technological and behavioural space and in time, and exemplifies the fact that, given the effects of environmental factors and the appropriability of any technological change, the technological decisions and behaviour of a firm in the past, define to a great extent its course (performance) in the future, and by implication its capacity and/or receptivity to adopt technological innovation.

In different terms, Burgelman and Rosenbloom (1989), by using 'evolutionary' assumptions, perceived technology as a functional 'capability' and as a result of firm's past behaviour and experience. In addition, Saren (1991), introduced, from a descriptive viewpoint, the concept of "technological ideology" which is "organization specific" and consists of "a set of common ideas and a collective way of thinking about the firm's technology". Saren postulated that "over time a firm's historical experience and know how 'crystallises into an ideology' which affects "the choice of 'route' of technological development for the firm. It delineates the course of future developments" (pp.7-9).

Figure 6.4.: Factors influencing intrasectoral differences in innovativeness



To summarize, recent empirical and theoretical insights into the adoption of innovation, as depicted in the three research directions reviewed above, have highlighted the following issues:- a) the adoption or buying process is a process of interaction among participants (suppliers and buyers, among others) and its quality, which determines largely its outcome, is influenced to a great extent, by the proactive and reactive actions of both suppliers and buyers, b) among other, technological asymmetries, varieties, and behavioural diversities among firms, which are the results of firms' past technological history and performance, are responsible for the varied degrees of innovation exploitation (adoption in this case) by individual firms.

The above issues, which are complementary rather than contradictory to each other, have not yet been taken fully into account in the marketing research tradition of the adoption of innovation. To this end, the author believes that there is room for promising integration among past and recent empirical and theoretical findings. However, it must be stated here that all models, reviewed above, investigate factors that influence adoption only after the innovation or product in question has been physically produced and has been made available for commercialization. To this end, as it was shown in Chapter 2, activities which have occurred during the development of the innovation and which affect its subsequent adoption and diffusion remain largely unexplored. Empirical evidence presented in Chapter 2 has already illustrated the potential gains for the study of adoption from the consideration of the developmental or pre-launch activities of an innovation.

Armed with the above insights, the next section will illustrate the conceptual framework of this thesis.

6.1.3. THE PROPOSED CONCEPTUAL FRAMEWORK

6.1.3.1. A RECAPITULATION OF THE STUDY'S DIMENSIONS

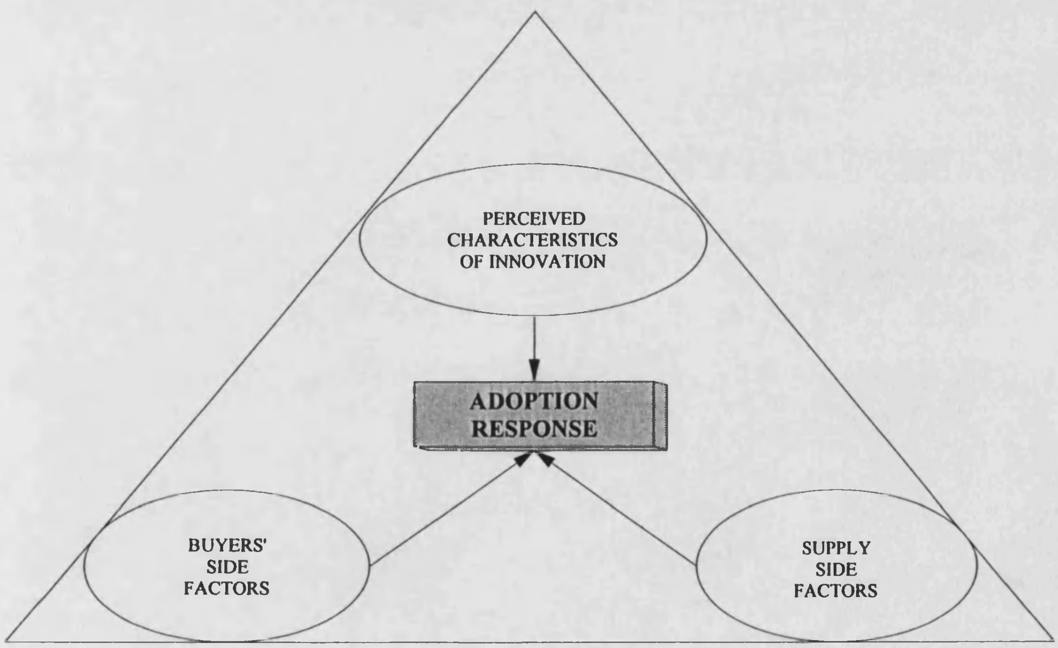
The overall objective of this thesis is to investigate what factors and in what way, have influenced the decision of some firms to adopt an innovation, by contrasting them to companies which, at the same point in time, have decided not to adopt the same innovation. In this respect, a large number of factors, as they have been developed by previous empirical and theoretical attempts, were reviewed in the first part of this thesis under the following headings:- a) Supply side factors, b) Innovation characteristics, c) Economic factors, d) Organizational/ Managerial factors. and e) Industry and Environment specific factors. Moreover, by applying a critical eye upon previous findings, controversies or inconsistencies among them were identified as well as, opportunities for integration and areas for further research, which have been considered in the development of the conceptual framework of this study.

6.1.3.2. THE CONCEPTUAL FRAMEWORK

The conceptual framework of this thesis is illustrated in the following figure 6.5. Essentially, it represents an attempt to integrate previous theoretical insights in the field and to fill some gaps which have arisen, inter alia, from the separate investigation of suppliers and buyers of technological innovation.

To this end, this framework distinguishes three main clusters of dynamically interconnected factors which influence the adoption response of a firm towards an innovation. These factors are related to **A)** supplier(s) of the innovation, **B)** potential buyers' perceived characteristics of the innovation and **C)** factors related to the conditions of the potential buyers.

Figure 6.5.: The Conceptual Framework



This framework is based upon the idea that suppliers and buyers interact with each other during the entire innovation process. It is their combined actions that mould the final form of the innovation which, in its complex format, is the output and the driving force of their interaction. This implies that, for industrial marketers who wish to have a clear understanding in advance of the factors impinging upon the decision of firms to adopt an innovation, it is misleading to investigate only the conditions of buyers and the innovation's perceived characteristics. They also should appreciate the participation of their firm in the innovation process, and realize that their activities are taken into account by buyers, when considering the adoption of the innovation. As such, the industrial marketer (or researcher) should investigate factors from all the above clusters, as well as their collective impact upon the adoption response of firms.

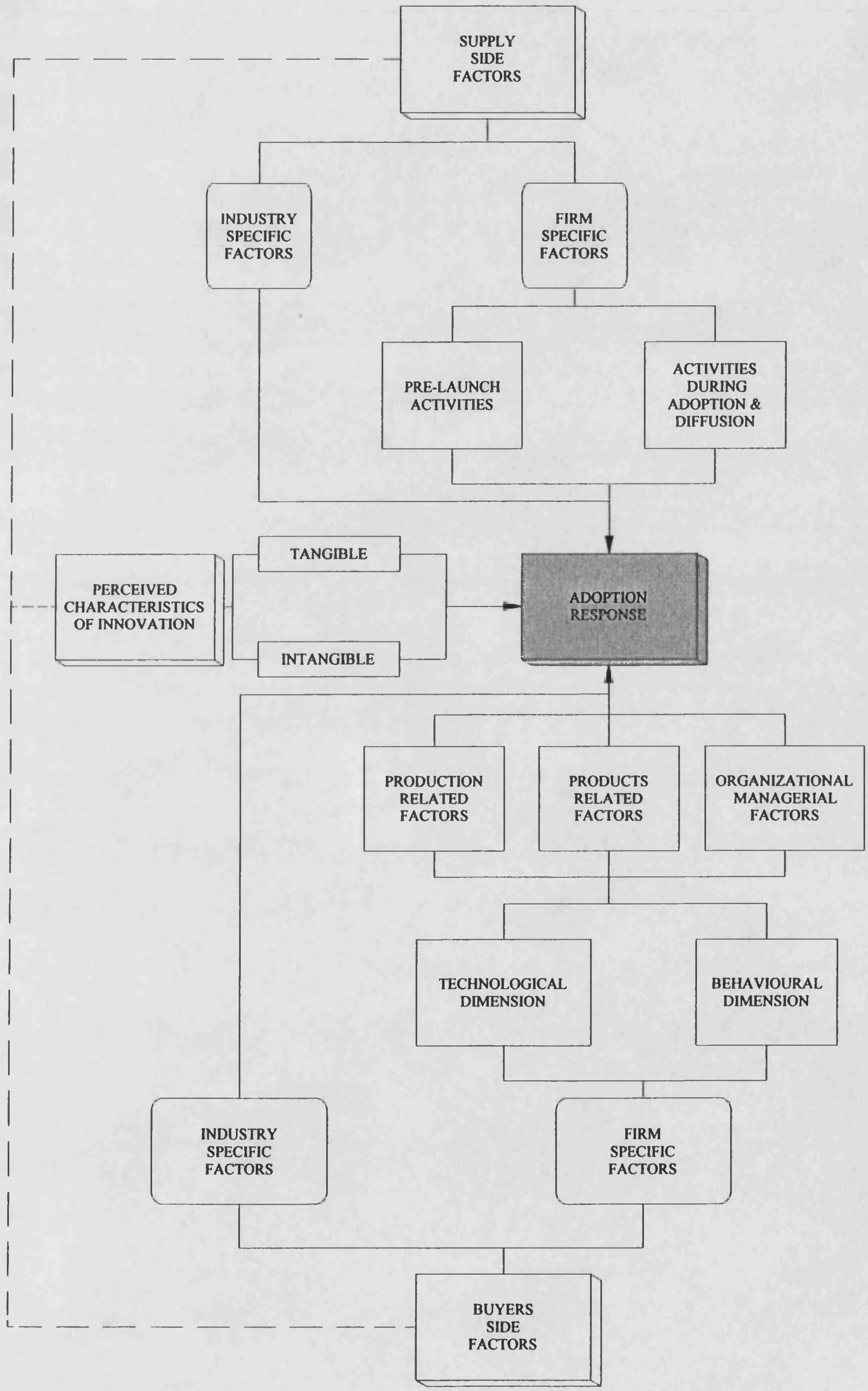
So comprehensive a framework is of little value in itself. However, the author finds this framework to be a useful tool for representing in an integrated, though comprehensive way, the key clusters of factors that affect adoption response towards an innovation and the linkage between suppliers and buyers in the innovation process. It is believed here that, in order to employ this framework as an analytical tool for the accomplishment of the study's objectives, its clusters should be dissected and the factors they incorporate should be unravelled. Such a dissection of the framework is presented in the following lines.

6.1.3.3. A DISSECTION OF THE CONCEPTUAL FRAMEWORK

The dissected conceptual framework of this study is presented in figure 6.6. Here, the framework is outlined again by its three main clusters of factors namely, supply side factors, perceived characteristics of innovation and buyers' side factors. However, each cluster of factors is dissected into sub-clusters which a) make the conceptual framework more specific and b) align its rationale with the objectives of the study and the particular issues which were identified by means of reviewing the field's literature.

The following discussion attempts to explain the different sub-clusters of the conceptual framework.

Figure 6.6.: The Dissected Conceptual Framework



1). ***Supply side factors***, as discussed earlier in chapter 2, break down to factors specific to the industry of the suppliers and firm specific factors which represent the innovation related activities of the suppliers. The latter activities are further distinguished into pre-launch activities and activities during the period of adoption and diffusion.

The foregoing conceptualization of supply side factors can be regarded as a direct response to Rogers's (1983) remarks that "...all past diffusion research studies begun with the left-hand tail of the S-shaped diffusion curve...have overlooked the fact that a great deal of relevant activities and decisions usually occurred long before the diffusion process" p.134.

Pre-launch activities include mainly the activities of the supplier towards the development of the innovation (NPD activities) and the plans on which the commercialization process of the innovation is going to be based. Activities during the adoption and diffusion period imply the supplier's efforts to market the innovation.

Nevertheless, as it was pointed out in chapter 2, the distinction between the two is not a real one since, and in particular for industrial products, marketing activities are evident both before and during the development process and further developmental activities occur during the adoption or diffusion process of an innovation. To this end, this conceptual framework introduces a 'heuristic' picture of the 'continuous' innovation process where, a continuous proactive and reactive interplay among suppliers and buyers takes place.

As such, this part of the framework stems from the theoretical and empirical work and suggestions of, among others, Rogers (1983), Robertson & Gatignon (1986), Hakanson & Ostberg (1975), Choffray & Lillien (1978).

2). ***Perceived characteristics*** of innovation, indicate in this conceptual framework the degree of 'fit' of an innovation with the objectives, needs and capabilities of a prospective adoptor. To this end, as it was highlighted in chapter 3, tangible and intangible characteristics of innovation are taken into account by a prospective adoptor and as such they influence his adoption decision.

3). ***Buyers' side factors*** include factors specific to the industry and the environment of the buyers as well as, factors specific to the buyers' firms. The incorporation of industry and environment specific factors in this conceptual framework is justified by the fact that, in spite of their paramount importance in the industrial adoption or buying process (Webster & Wind 1972), they have been investigated only to a very limited extent (Gatignon & Robertson 1986, Rothwell 1977).

As it was shown previously (Chapter 4), factors specific to the buyers' firms outline, mainly, the determinants of the 'innovativeness' of organizations towards innovations. Extant determinants of innovativeness of organizations include, primarily, economic and behavioural (organizational/managerial) factors. However, in chapter 1 of this thesis, the extant concept of innovativeness was debated and a new concept was put forward. The latter suggests that innovativeness of organizations represents a latent capability of firms which is composed of two critical dimensions, a technological and a behavioural one. To this end, innovativeness of organizations, in the present thesis, is conceptualized as a factor that mediates, among other factors, the adoption of a technological innovation. Bearing in mind the work of Dosi (1988) reviewed above, the present framework suggests too that historically formulated asymmetries among firms with regard to their technological and behavioural dimensions, are responsible, inter alia, for the differences in their overt behaviour (adoption response) towards innovation.

For a researcher to be able to capture these two dimensions of innovativeness of organizations, indicators need to be formulated which will reflect these dimensions. To this end, as it is shown in figure 6.6., the conceptual framework of the present study breaks down the technological and behavioural dimensions of the innovativeness of organizations to production (machinery & equipment) factors, products related factors, and organizational/ managerial factors. It suggests that, with regard to the adoption of technological innovations, an inquiry into these factors can provide hard data to a researcher for capturing the two dimensions of innovativeness of organizations. This in turn, can be used for the assessment of technological and behavioural asymmetries among firms and therefore, for the exploration of their influence upon the adoption response of firms towards an innovation.

More specifically the present framework postulates the following:-

a). Machinery & equipment and products of a firm are artefacts which manifest part of the technology history of a firm (or history of technological accumulation), and as such define the capabilities (constraints and opportunities) of the firm in exploiting new technological innovation. This assertion is by no means solely the author's conjecture. Similarly, Webster & Wind (1972) postulated that "technology defines the plant and equipment of the organisation, and these, in turn, place significant constraints upon the alternative buying actions available to the organizations" (p.17). However, it must be stated here that the author's conception of technology and technology history of a firm is a broad one, embodied both in artefacts and people (Burgelman & Rosenbloom 1989, Nelson 1987), where specific aspects of the latter category are physically manifested by the former (Saren 1991, Nelson 1987).

b). Organizational/managerial aspects of a firm, as defined in chapter 4, are composed of factors which mediate attitude and behaviour towards innovation, and as such are responsible for the behavioural diversities among firms.

As it can be seen from the above categorization of firm specific factors, economic factors relevant to firms have been intentionally excluded. This is not to say that issues relevant to production (machinery and equipment), products or organizational and managerial aspects are free of economic considerations. However, instead of including economic factors, such as performance gap, liquidity, and profitability of the firm, and thus confining the researcher to economic interpretations or confusing behavioural (as shown in chapter 4), factors external and internal to the firm are considered which ultimately, are the underlying causes of firms' performances.

Hitherto, the conceptual framework of this thesis has brought together, by using a critical perspective, a repertoire of concepts relevant to the industrial adoption of technological innovation. The organization of these concepts within this framework postulates the following conceptualization of the adoption of technological innovation.

A firm is perceived as operating within a polymorphous environment that creates incentives, opportunities and constraints to its activities. Within this setting, the adoption of a technological innovation constitute an alternative for the firm in order to pursue its strategic plans or tactical manoeuvres, which will enable it to maintain or even increase its competitive position. Given the technological developments in the environment, a viable subscription of a firm to this alternative will depend upon its capabilities, as they have been formulated by its history of technological accumulation and by its organisational and managerial practices. Successively, the adoption or rejection of a specific innovation will depend upon the degree of its perceived 'fit' to the particular objectives, needs and capabilities of that firm. Such 'fit' is manifested through the perceived characteristics of the innovation which, however, are molded by the ever proactive and reactive interaction among suppliers and buyers within the continuous innovation process.

Nevertheless, as in any other study, the specific objectives of the present thesis impose limitations in the conceptual framework employed here. There-fore, the author deems that, before any attempt of other researchers to use the present framework in their own studies, the following points need to be acknowledged.

1. Adoption response in the present framework represents the overt behaviour of a firm towards the adoption of an innovation at a point in time. However, it is well known that, this decision (overt behaviour) is reached by means of the adoption decision-making process (or innovation-decision process) which has been conceptualized as a sequential process (Baker, 1983) or as composed of different stages (Rogers 1983, Zaltman et al. 1973). There-fore, researchers, wishing to investigate the impact, upon different stages, of the adoption process of the factors hypothesized in the present framework to influence the adoption response of firms, should incorporate in this framework the different stages of the adoption decision-making process.

2. It is well established that, the adoption response of firms is formulated by means of a decision making unit (DMU), where different individuals play different roles. Therefore, the existence of a DMU also should be incorporated in the present framework by researchers wishing to explore how different factors impinge upon the decisions and concerns of individuals performing different roles within the decision making unit.

3. The present framework suggests that, the technological dimension of the innovativeness of organizations can be traced by means of factors related to the production process and the products of firms. This can be justified by the fact that, the technological innovations which are investigated by means of the research design of the present study, relate to the production process and the products of the firm. The author acknowledges that, in situations where the technological innovation is applicable to other areas of the organization, asymmetries in the technological dimension of innovativeness of organizations should be traced mainly in the areas where the innovation applies and/or areas, which their technology impose constraints and opportunities to the firm vis-à-vis the innovation in question.

The latter, brings forward an argument which states that, owing to the natural industry life cycle (Utterback and Abernathy, 1976), in some circumstances asymmetries among firms may get extinguished. How, then, can the present conceptual framework account for the factors to impinge upon the adoption response, in the case of firms in a mature industry which, are faced with a new and potentially superior technological innovation that comes into existence? With regard to this case, evidence suggests that a factor of extreme importance is whether the new technology is compatible with the capabilities of extant firms, or requires different kinds of capabilities.

Tushman & Anderson (1986) call these technological innovations 'competence enhancing' and 'competence destroying'. To this end, as it is shown above, the present conceptual framework incorporates, in addition to technological and behavioural asymmetries among firms, factors related to the characteristics of the technological innovation and examines their 'fit' with the needs, objectives and capabilities of prospective adoptors.

4. However, Tushman and Anderson (1986) suggest that, for an old firm facing the above situation a change in strategy is needed for that firm to survive in the new environment. This

is in line with the recent emphasis on the role of 'strategy' in determining the nature and direction of technological innovation.

Nevertheless, Nelson (1991) argues that capabilities of firms are far more difficult to change than management and articulated strategies. But, there is something to this argument. Strategy and changes in strategy call forth and mould the capabilities of organizations. Therefore, one may argue that organizations following a proactive strategy are in a better position, than firms following a reactive strategy, to have (or to be able to acquire) the capabilities needed for the adoption of a technological innovation. Thus, proactive firms will usually be ahead of reactive firms in the adoption of technological innovations. The author deems that the latter should be a proposition rather than an assumption. Its axiomatic nature is doubted because **a**). firms do not always behave true to their strategic type (Freeman 1982) and **b**). firms' strategies seldom determine the details of firms' actions (Nelson 1991).

Of course, the author acknowledges that, any firm needs a reasonably coherent and accepted strategy because otherwise, decision making about rival claims on resources (such as those needed for the adoption of an innovation) has no legitimate basis (Nelson, 1991). But, it is one thing for a firm to intend to pursue an innovative strategy and quite another for the required capabilities to be in place or to be made available. Obviously, the latter creates a *'puzzle'* to the industrial marketer who expects diversities among firms and wants to know how the strategy followed by a firm impinge upon its decision to adopt or not his firm's technological innovation. This *'puzzle'* may be resolved by the fact that "the reality of strategy lies in its enactment, not in those pronouncements that appear to assert it" (Burgelman & Rosenbloom 1989, p.19). Clearly, the enactment of any strategy is reflected upon the diversities among firms and as such, upon the technological and behavioural asymmetries among them.

The discussion above indicates that the concept of strategy and its influence on the adoption of innovations is a very complex one. As such, as it was stated in chapter four the latter issue is out of the reach of the present study. However, despite its complexity the author deems that the influence of strategy on the adoption of innovations is an important issue and it can be examined effectively only by a much more focused research to strategy than by the one reported here.

At present, the conceptual framework of this thesis, alongside the literature, reviewed earlier, assists the selection of variables which are expected to influence the adoption response of firms as well as, the formulation of relevant hypotheses. The next section will present these hypotheses and this chapter will continue proposing a field work to be undertaken for the testing of these hypotheses.

6.1.4. STATEMENT OF HYPOTHESES

Before stating the hypotheses to be tested in this thesis, it must be mentioned that they represent the major factors found in the literature review to influence the industrial adoption of technological innovation. However, their scope is, intentionally, limited to those which are amenable to measurement and testing in the field work. As such, they, by no means, constitute an exhaustive representation of all the factors that might affect adoption. The following hypotheses must be perceived, therefore, as a first attempt to fill in the clusters of factors that the conceptual framework postulates to have an influence upon the adoption response of firms towards technological innovations. Some of these hypotheses are directly supported by past empirical work in the field, while others are logical extensions of the ideas, trends and suggestions identified previously in the literature review.

Armed with the above insights, the remaining part of this section will present the hypotheses which will be examined in this thesis. Following that, table 6.1. illustrates the association among the past theoretical and empirical evidence reviewed earlier and the hypotheses, alongside their corresponding variables which are examined in this thesis.

A).THE BUYER'S SIDE

a1). ENVIRONMENT AND INDUSTRY SPECIFIC FACTORS

Other things being equal, a firm's perception of its external environment is associated with its adoption response towards a technological innovation (derived from Chapter 5, See also table 6.1. and Ch.7 sect.7.4). More specifically:

H. 1: The faster it is perceived by a firm the entry rate of new firms in its industry, the more likely it is that firm to have a positive adoption response towards innovation.

H. 2: The lower the price competition faced by a firm, the more likely it is that firm to be able to afford the investment required for an innovation and thus to have a positive adoption response.

H. 3: The more the competition in a firm's products' characteristics, the more likely it is that firm to have a positive adoption response towards innovation.

H. 4: The more the competition in a firm's promotional activities, the more likely it is that firm to have a positive adoption response towards innovation.

H. 5: A frequent introduction of new products in a firm's industry is positively related with that firm's readiness to adopt an innovation rather than to reject it.

H. 6: The better the conditions of a firm's raw materials, as determined by their technological status and the industry's technical change, the more it is expected that firm to have a positive adoption response towards innovation.

H. 7: The better the conditions of a firm's machinery, as determined by their technological status and the industry's technical change, the more it is expected that firm to have a positive adoption response towards innovation.

H. 8: The better the conditions of a firm's production methods in use, as determined by their technological status and the industry's technical change, the more it is expected that firm to have a positive adoption response towards innovation.

H. 9: The more the technical specifications demanded by a firm's market, the more likely it is that firm to adopt an innovation.

H. 10: The more the receptivity of a firm's market to technological innovation, the more likely it is that firm to adopt an innovation.

H. 11: Firms which have introduced more new production technologies due to their customers requests, are expected to adopt an innovation rather than to reject it.

H. 12: Firms which have introduced more new products due to their customers requests, are expected to adopt an innovation rather than to reject it.

H. 13: The more the communication activities of a firm, the more likely it is that firm to have a positive adoption response towards innovation.

H. 14: The more positive it is perceived by a firm the governmental attitude towards the industry, the more likely it is that firm to adopt an innovation rather that to reject it.

a2). FACTORS RELATED TO THE PRODUCTION PROCESS AND THE PRODUCTS

Other things being equal, the machinery & equipment and the technology employed by a firm as well as its products have a direct influence upon that firm's adoption response towards innovation (Derived from Chapters 4 and 8, See also table 6.1., Ch.7 sect.7.5). More specifically:

H. 15: A very high capacity utilization rate by a firm, is expected to impede the adoption of innovation by that firm.

H. 16: The larger the percentage of a firm's sales which are generated by new products, the more likely it is that firm to have a positive adoption response towards innovation.

H. 17: The more a firm's dependence upon few products, the less likely it is that firm to adopt an innovation.

H. 18: The more a firm's dependence upon few customers, the less likely it is that firm to adopt an innovation.

H. 19: Firms which adopt innovation are expected to have a higher past record of investments in new technology than non-adoptors do.

<u>**H. 20**</u>: The better the technological base of a firm, the more likely it is that firm to have a positive adoption response towards innovation.

a3). <u>ORGANIZATIONAL AND MANAGERIAL FACTORS</u>

Other things being equal, organizational and managerial aspects of a firm determine that firm's receptivity to innovation and consequently its adoption response towards innovation. (Derived from Chapters 5, See also table 6.1., Ch.7, sect.7.6). More specifically:

<u>**H. 21**</u>: The higher the research and development activities of a firm, the more likely it is that firm to adopt an innovation.

<u>**H. 22**</u>: Firms engaging in strategic planning are expected to have a positive adoption response towards innovation.

<u>**H. 23**</u>: The higher the participation of lower level employees in the decision making process of a firm, the more likely it is for that firm to have a positive adoption response towards innovation.

<u>**H. 24**</u>: The higher a firm's centralization, the less likely it is for that firm to have a positive adoption response towards innovation.

<u>**H. 25**</u>: Formalization is negatively associated with the adoption of innovation.

<u>**H. 26**</u>: Adoption of an innovation is more likely to occur in firms which receive more frequently, than other firms, proposals for the introduction of innovative products.

<u>**H. 27**</u>: Adoption of innovation is more likely to occur in firms which have a formal recruitment programme.

<u>**H. 28:**</u> The more a firm encourages its employees to participate in scientific events the more likely it is that firm to have a positive adoption response towards an innovation.

<u>**H. 29**</u>: The more favorable it is the attitude of a firm towards innovation, the more likely it is that firm to adopt an innovation.

B). INNOVATION' CHARACTERISTICS & PERCEIVED RISK

Other things being equal, the perceptions a firm has, for the characteristics of an innovation and the risk attached to its adoption, are connected with the adoption behaviour of that firm (Derived from Chapter 3, See also table 6.1., Ch.7 sect.7.3). More specifically:

H. 30: The greater it is a firm's perception of an innovation possessing the following characteristics, the more likely it is that firm to adopt this innovation rather than to reject it (Characteristics included: 1). low initial cost, 2). low maintenance cost, 3). low running cost, 4). short pay-back period, 5). high flexibility in use, 6). high reliability in operation, 7). ease in understanding its use, 8). saves labour, 9). improves the quality of the end product, 10). saves factory space, 11). compatible with existing manufacturing operations, 12). compatible with existing technical experience and expertise, 13). lowers the unit cost of the end product, 14). permits trial in a small scale, 15). introduces savings in production time, 16). increases variety of end products, 17). encompasses advanced technology).

H. 31: The more confident a firm is, a). for the supplier's credibility, b). the technical characteristics of the innovation and c). its expected advantages the more likely it is that firm to have a positive adoption response.

C). THE SUPPLIER'S ACTIONS

Other things being equal, the suppliers' activities and the way in which they are perceived by the potential adopting firm, are connected with the adoption behaviour of that firm (Derived from Chapter 2, See also table 6.1., ch.7, sections 7.3, 7.2, 7.1). More specifically:

H. 32: The more it is, a firm's perceived sufficiency of the information provided by the supplier of an innovation the more likely it is that firm to have a positive adoption response towards the innovation.

Furthermore, as it was suggested in chapter 2, suppliers' development and other marketing activities are expected to have an influence upon the adoption decision of individual firms. However, owing to, yet, limited understanding of this area no explicit hypotheses were developed. Rather, it was decided to explore and compare the development and marketing activities for specific innovations with the reasons for their adoption or rejection by potential adoptors. The aim of this was to find which specific activities, how and why, have influenced the adoption response of different firms.

The following table 6.1. illustrates a).the hypotheses and the related variables of the study, b). a brief explanation of the variables' operationalization, c). a brief theoretical justification of each variable and d). the thesis's chapters where a discussion of each variable can be found.

Table 6.1.: The Hypotheses of the Study

HYPOTHESES & RELATED VARIABLES		OPERATIONALIZATION	THEORETICAL JUSTIFICATION	RELEVANT CHAPTERS
A. BUYERS SIDE				
A.1. INDUSTRY SPECIFIC FACTORS				
A.1.1. COMPETITORS COMPONENT				
H.1	New Firms Entry Rate	Scale 1: Very slow 7: Very fast	Comanor 1967, Levin 1978, Globerman 1975	5 7.4
H.2	Intensity and importance of price competition	Construct See Section 7.4.	Romeo 1975,77, Globerman 1975, Kimberly & Evanisko 1981, Gatignon & Robertson 1989, Schumpeter 1942	
H.3	Intensity and importance of competition in product characteristics	Construct See Section 7.4.		
H.4	Intensity and importance of competition in promotional/service activities	Construct See Section 7.4.		5 7.4
A.1.2. TECHNOLOGICAL COMPONENT				
H.5	Rate of new product introduction	Scale 1: Almost Never 7: Very Often	Bright 1964, O'Neal 1973, Antonelli 1989 Bundgaard-Nielsen & Fiehn 1974	5 7.4
H.6	Technological challenges in raw materials	Construct	Based on the ideas of Dosi 1988, raised in Chapter 7 and Chapter 8	
H.7	Technological challenges in machinery	Construct See Sect. 7.4		5
H.8	Technological challenges in production methods	Construct		6 7.4
A.1.3. CUSTOMERS COMPONENT				
H.9	Technical specification demanded by the market	Scale 1: Of low level 7: Of high level	Based on the work of Hippel 1997a, 1977b, 1978, Foxall 1984, 1988, 1989, Khandwalla 1972 Balbridge & Burnham 1975	
H.10	Market receptivity of technological innovation	Scale 1: not receptive 7: very receptive		
H.11	Introduction of new production technologies due to customers' demands	Scale 1: not at all 7: to a great extent		
H.12	Introduction of new products due to customers' demands	Scale 1: not at all 7: to a great extent		5 7.4

(cont)

A.1.4. COMMUNICATION COMPONENT				
H.13	A. Communication with scientific institutions A.1. Frequency A.2. Easiness A.3. Importance B. Communication with similar firms B.1. Frequency B.2. Easiness B.3. Importance C. Communication with customers C.1. Frequency C.2. Easiness C.3. Importance	Scales 1: rarely, 7: very often 1: v. easy 7: v. difficult 1: not important at all 7: very important	Based on the work of: Hippel 1989, Carter & Williams 1958 Martilla 1971, Goldhar et al 1976 Rogers 1983	5 7.4
A.1.5. SOCIO-POLITICAL COMPONENT				
H.14	Governmental attitude towards innovation	Scale 1: negative 7: very positive	Rubenstein et al 1977 Bollinger et al 1983 Parkinson & Avlonitis 1986	5 7.4
A..2. PRODUCTION AND PRODUCT RELATED FACTORS				
H.15	Capacity utilization rate Capacity utilization rate in comparison with similar firms	Percentage Scale 1: lower 7: higher	Mansfield 1968b	4 7.5
H.16	Sales due to new products	Percentage	Abu-Ismail 1976	4 7.5
H.17	Dependance upon few products	Percentage	Mansfield 1968b	4 7.5
H.18	Dependance upon few customers	Scale 1: not at all 7: to a great extent	Based on : Mansfield 1968b, Wilson & Corb 1983	4 7.5
H.19	Investment for new technologies during the last 5 years	Percentage	Projection from Dosi's 1988 ideas regarding the issue of new technology accumulation	6 7.5
H.20	Adequacy of firm's technological base	Scale 1: not at all 7: to a great extent		
A.3. ORGANIZATIONAL AND MANAGERIAL FACTORS				
H.21	Existence of an R&D department Collaboration with research institutions	Dichotomous (Yes/No)	Mansfield 1968b	4 7.6
H.22	Existence of strategic planning	Dichotomous (Yes/No)	Baker 1975a, Abu-Ismail 1976, Globerman 1975a,b	4 7.6
H.23	Participation in decision making	Hage & Aiken scale, See section 7.6	Hage & Aiken 1967 Aiken & Hage 1971 Corwin 1972 Zaltman et al 1973 Abu-Ismail 1976 Pierce & Delbecq 1977 Kim 1980 Ettlie et al 1984 Cohn & Turyn 1984 Speckman 1979 Koehler & Tebbe 1985	4 7.6
H.24	Hierarchy of authority			
H.25	Degree of formalization			
H.26	Frequency of proposals for new products from outside sources Frequency of proposals from inside sources	Scale 1: rarely 7: very often	Carter & Williams 1958, Martilla 1971, Czepiel 1974, Dewar & Dutton 1986, Robertson & Gatignon 1986	4 7.6
H.27	Existence of formal recruitment policy	Dichotomous (Yes/No)	Carter & Williams 1958 Cohn 1980, Baker 1975a	4 7.6

(cont.)

H.28	Encouragement to attend national scientific conferences Encouragement to attend international scientific conferences Encouragement to participate in professional and scientific associations	Scale 1: not at all 7: to a great extent	Freeman 1973 Abu-Ismail 1976 El-Sherbeny 1979	4 7.6
H.29	Attitude of managers towards innovation Attitude of employees towards innovation	Scale 1: not favourable at all 7: very favourable	Carter 7 Williams 1958, Baker 1975a, Shepard 1967, Rothwell 1977, Dewar & Dutton 1986, Twiss 1986, Ozanne & Churchill 1971	4 7.6
B.1. INNOVATION CHARACTERISTICS AND PERCEIVED RISK				
H.30	Innovation possessing a number of attributes Perceived attributes total score	Scale 1: not at all 7: to a great extent Construct, See Sect. 7.3	Rogers & Shoemaker 1971 Rogers 1983, Fliegel & Kivlin 1966, 1967, 1968, Tornazky & Klein 1982, Hayward 1975, Hayward et al 1976, 1977 Cooper & Zmud 1990	3 7.3
H.31	Perceived confidence	Construct, See Sect. 7.3	Peters & Venkatessen 1973, Hawes & Barnhouse 1987	3 7.3
C.1. SUPPLY SIDE RELATED FACTORS				
H.32	Information for technical characteristics Information for financing the adoption Information for competitive advantages Information for industry trends Information for supplier's image & credibility Information for R&D expenses spent Information for after-sales service	Perceived sufficiency of information provided by the supplier. Measured by scales, where: 1: not sufficient at all 7: very sufficient	Based on the ideas developed in Chapter 3 Also, Hakanson & Wootz 1975 Bettman 1973 Roselius 1971	2 3 7.3

The next section will present the research methodology undertaken to examine the above issues.

6.2. RESEARCH METHODOLOGY

6.2.1. INTRODUCTION

The formulation of the methodology for this research was based upon the requirements for an efficient testing of the relevant hypotheses and the issues derived from the conceptual framework of the study. As such, the integrative nature of this study necessitated the development of a methodology which will allow for the investigation of the entire scope of the innovation process i.e. development-introduction-adoption/diffusion. This meant that both producers/ suppliers and potential adoptors of specific innovations had to be identified. Moreover, the purpose of this study is to investigate what factors and in what way have influenced the decision of some firms to adopt an innovation by contrasting them to a group of companies which, at the same point in time have rejected the same innovation. Therefore, potential adoptors had to be distinguished into firms that adopted a specific innovation and firms that have rejected it.

To this end, it was felt that one could accomplish the above by selecting specific innovations and then tracing their producers/suppliers, as well as the firms that have either adopted or rejected each innovation.

This section will describe the steps and procedures followed for the selection of innovations, the conduct of the field study and the analysis of the empirical data collected. These issues will be presented in the following sequence:

1. Choice of innovations
2. Identification of the firms that have produced/supplied the innovations under consideration, as well as firms that have adopted or rejected each of the above innovations.
3. Development of the research instrument.
4. Measurement of variables included in the research.
5. Choice of statistical methods to be used for the analysis of data collected in the field.

However, prior to any explanation regarding the steps followed in this study, there are two issues which need to be briefly clarified. The first one is the choice of Greece as the country where the research is conducted and the second one is the choice of small firms as the sampling units.

6.2.2. PLACE OF THE RESEARCH & CHOICE OF SMALL-SIZED FIRMS

Regarding small-sized firms it is acknowledged that they foster the growth of new industries and the emergence of major new product groups (Rothwell 1983) by means of 'entrepreneurial' innovation (Freeman et al. 1982). According to Rothwell (1984), active presence of small firms in any economy give rise to "dynamic complementarities" (p.22) between them and large firms which in turn elevates the Schumpetarian industrial evolution process (Schumpeter 1942). Moreover, Rothwell (1978) stated that rapid technological change is best fostered by a system of many small firms rather than few large ones.

Addressing the issue of small-sized British firms, Foxall (1986) postulated that their survival and growth are of primary concern in any investigation of Britain's economic competitiveness and industrial regeneration.

Despite of their importance, small-sized firms are plagued with a very high mortality rate (Waite 1973, Rothwell 1978, El-Namaki 1990). Research efforts in the area of small firms have identified many of their problems and have suggested many alternatives towards their remedy (Cooper 1966, Hlavacek et al. 1977, Wilson & Cord 1983, Bamberger 1989, Forrest 1990). Recently, Steiner et al. (1988), as well as Shroeder et al. (1989) concluded that, overall, the adoption of new technologies is a necessary and regular part of doing business if a small manufacturer is to stay competitive.

In view of the new technological developments, Meredith (1987) and Dodgson (1987) have argued in favour of the applicability and strategic advantages of new manufacturing technologies for small firms. Nevertheless, El-Namaki (1990) postulated that small firms do not absorb new technology because of a) the lack of specific technological experience in the firm, b) the integrated nature of the technology itself, and c) the degree of user-friendliness of the hard and software. Contrary to this opinion, Goldberg (1978) and Rothwell (1984), among others, have cited many examples where small firms have been prime channels for technology transfer between nations and have been responsible for the rapid market diffusion and commercial exploitation of new technologies. This confusion can be attributed to the limited understanding of new technology adoption in small-sized firms, as opposed to large firms (Lefebvre et al. 1991), which in turn, calls for more research in this area and justifies the orientation of the present study.

Regarding the place of the research, two reasons contributed mainly to the choice of Greece. Firstly, the fact that the author being from Greece had sufficient knowledge of the conditions inherent in the Greek industry to allow him the best possible conduct of the research. Secondly, the fact that, in spite of the extreme importance of technological innovations and industrial marketing for the economic development of the country, very little research has been done in this direction in Greece. With regard to industrial marketing, Avlonitis (1988) concluded that 61% of the Greek's economy exchanges in monetary terms were of an industrial nature. In addition, Skoumal and Kazis (1985) concluded that too little has been done in the past for the development of original know-how in Greece which will be needed for defensive flexibility in the face of future competition within the EEC. To this end, this study, by examining both the development and adoption records of specific innovations in Greece, is expected to assist the formulation of any efforts towards advancing the technological level of Greece's industry.

Finally, it was felt that no bias or limitation on research findings was introduced due to the place of the research for the following reasons:

1. Greece since 1981, is a full member of the European Economic Community (EEC). As such, it competes with other European countries in the same international market place and under similar environmental influences.

2. Greece's industry resembles the industries of other European countries in the respect that it has a diverse range of industrial sectors ranging from traditional ones which bear intense domestic and international competitive threats (i.e. Textiles, Food products, Minerals), to fast growing sectors such as Chemicals, Appliances, Transportation equipment, Machinery construction.

6.2.3. THE SELECTION OF INNOVATIONS

The process for selecting innovations to be considered in this study was guided by the following conditions: a) innovations had to be really innovatory from a technological point of view; this is, the innovations had to incorporate new technological aspects, b) innovations had to have entered the commercialization process but not very long ago, so as to be easily recalled, and c) they had to have been adopted by sufficient number of firms to allow for a diversity of opinions and use of appropriate statistical methods. To this end, the following procedures were followed.

6.2.3.1. PROCEDURES

A frequently used technique for the selection of innovations, by adoption and/or organizational buying researchers, is consultation of industry experts and lists[20] of innovations in the industry (e.g. Baker & Parkinson 1976, Dewar and Dutton 1986).

The present study employed a similar technique. To this end, the author found a list of innovations produced in Greece, by approaching two public organizations, namely OPE (Organization for Exports Promotion) and EOMMEX (Greek Organization for Medium and Small size manufacturing firms and Handicraft), and the Ministry of Industry Research and Technology were approached. EOMMEX since 1982, has started a programme under the support and encouragement of EEC and OECD, which aims at promoting and enhancing 'inventional and innovational' activities of small and medium manufacturing firms through provisions of grants. Before any provision, an evaluation of the technological aspects of the product or process takes place. The team of evaluators is composed of technicians from EOMMEX, from the Ministry of Industry Research and Technology and Academicians. Only after the product or process under consideration is evaluated as possessing new technological aspects is allocated the necessary grants. Access to the relative files of the evaluators and discussions with persons from EOMMEX enabled the choice of three innovations which fulfilled the above requirements. These innovations are:

1. ***Wire Bending Computer Numerical Control Machine***
2. ***Numerical Control Packaging Machine***
3. ***Switching Power Supply System***

The innovations in the above sample are two machine tools (1,2), and a component (3). The CNC Wire Bending Machine is used for the production of frames for innerspring mattresses and it is a unique innovation. The Packaging Machine is vertically loaded volume-metric and it is used for the packaging of products such as agricultural e.g. beans, dried fruits, and chemicals in powder or dried form. The Switching Power Supply System is used for controlling and converting the incoming line power as required by the operating

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[20] e.g. SAPPHO's list of innovations, technical pages of Financial Times, lists of innovations that have received the Queen's Award for Technological Innovations in Britain.

device on which it is adjusted. A description of each innovation and their technical characteristics can be found in the Appendices A & B.

The next step was to contact the producers of the innovations and to compile a list of adoptors and non-adoptors.

6.2.3.2. ALTERNATIVES

An alternative to the above might have been to conduct a prior research in the Greek industry so as to identify the innovations adopted and then to choose out of them those for further investigation. In fact this has been done during the MBA thesis of the author (Tzokas 1987) but the innovations listed were either adopted by a very small number of firms[21] (2-3) or were imported thus, prohibiting a sufficient sample and a close and extensive contact with the producer.

6.2.4. SAMPLE (ADOPTORS AND NON-ADOPTORS)

As it was mentioned earlier the producers of innovations were contacted and were asked to provide a list of firms that have adopted their innovations along with another list of firms that have approached them or have been approached by them but, finally have not adopted the innovations. The latter was expected to warrant sufficient knowledge of the innovations and could assist the better investigation of the reasons for not adopting the innovation, and the comparison of the effects of the supply side activities.

These lists included the addresses and telephones of the firms and thus it was possible to contact them by telephone and to persuade them to participate in this research. Thus, 17 adopters and 12 non adopters were approached alongside the 3 firms which produced the innovations. The number of firms in each category is presented in the following diagram.

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[21] Similar problems have been reported by Baker and Parkinson, 1976.

INNOVATIONS	PRODUCERS	ADOPTERS	NON-ADOPTERS
CNC BENDING MACHINE	1	6	4
NC PACKAGING MACHINE	1	6	4
SWITCHING POWER SUPPLY	1	5	4
Total	3	17	12

6.2.4.1. ALTERNATIVES

An obvious argument regarding the existence of sampling bias would have been the fact that the list of non-adoptors which was provided by the producers indicated only those firms which they were interested in investigating why they declined the adoption of their innovation. Although it was explicitly explained to them from the first contact that they should not do that, even if they intentionally did it, it is felt that this introduces no bias but instead it ads to a more realistic nature of the research. Indeed, firms which the producer wants to be adoptors of his innovation cannot be but influentials and decisive to the further diffusion of the innovation. It is then very important from a theoretical and practical point of view for a researcher to be able to identify those firms, analyse their behaviour and the reasons why they did not adopt the innovation.

Alternatively, a random or probabilistic sampling procedure including all the firms which might be potential adoptors seemed not appropriate because it could not warrant the prior knowledge of the innovation and the reception of information from the producer. The latter of course could have been checked by prior research in the industry which at that time was found to be not only very expensive but also very time consuming.

The above selection of innovations and firms (producers, as well as adopters and non-adopters) produced a limited cross-sectional research design. This is in line with Robertson's and Gatignon's (1986) suggestions for the efficient exploration and testing of hypotheses related to both suppliers and adoptors of different industrial innovation. Still, an alternative might have been the use of a longitudinal research design. According to Baker (1991), use of longitudinal research enables the researcher to avoid an inherent weakness of the one-off cross-sectional studies, namely that of the retrospective provision and explanation of events.

However, such a research design was not employed in this case mainly because of the time and costs requirements entailed by the simultaneous over time investigation of both the development and adoption processes for each innovation. Moreover, since innovations have entered the commercialization process not very long ago, it was felt that errors introduced by the recall of facts and events was minimised.

Overall, the research design employed here is dealing with the adoption response of firms towards specific innovations that have been produced by specific firms. Moreover, the identification of adoptors and non-adoptors is made by means of the help of the producer firms. Similar research designs have been used by many researchers in the adoption of innovations or organizational buying disciplines (e.g. Baker 1975a, Baker and Parkinson 1976, Peters and Venkatesan 1973, Metcalfe 1972, Griese and Kurpicz 1985, Shroeder 1990, Holak and Lehmann 1990). As it was shown in Chapter 1, although the above researchers were investigating the adoption of 'branded' innovations they were claiming that innovations in their research designs were representative of 'product classes'. This then, was attributed to the need of every researcher to claim that his/her study's results are generalizable to every other product in the same product class. Moreover, it was held, partly, responsible for the limited attention of innovation researchers to the influence upon the firms' adoption decision of the source of supply (supply side factors) and the intangible characteristics of the innovation. However the examples mentioned above reveal one more underlying reason for this treatment. This is, the particular objectives and the theoretical perspectives employed by the researchers.

As such, Baker & Parkinson (1976) were pioneering the concept that adoption response of firms can be better explained by a combination of behavioural factors, innovations characteristics and economic factors, rather than by economic factors alone. As such, factors related to the supply side (producers) were not considered in their framework[22].

[22] The author acknowledges Baker's and Parkinson's (1976) suggestions that, future research should focus on: a) "the innovator(s) approach to new product development and attempts to identify and cultivate receptive market segments for its products...", and b) "the potential adoptor's perceptions of the innovator(s)..." p.118.

By the same token, Holak and Lehmann (1990) were focusing upon the impact of innovations' attributes on the planned adoption of consumer durable innovations. Thus, whilst many of the innovations used in their research design were 'branded' and 'unique' products, they communicated the innovations to their respondents "without reference to specific manufacturers to avoid biasing responses" p.64. The investigation of the latter 'bias' (translated as the influence of the supply side upon the adoption response of firms) is one of the objectives of the present study. Nevertheless, the author made considerable efforts to eliminate any biasing of the responses owing to the fact that, the source of supply was known and, suppliers and potential adoptors had a contact in the past. These efforts included: a) stressing the confidentiality of their responses, b) clearly explaining that the researcher had no relationship with the supplier or any other research agency and c) stressing the fact that, the research was undertaken for scientific purposes and within the frame of the author's doctoral studies.

However, Johne (1986) remarked that innovation studies focusing on speed in adopting a particular brand may "give totally misleading results because a firm using such a research design can be classified as a later adopter merely on the grounds of having bought a competitive brand earlier than the brand being studied" p.151. The latter risk was eliminated in the present study by means of the high degree of researcher control which accrued from the personal interviews within the adopting and non-adopting firms. As it will be seen later in chapter seven, section 7.1, it was found that five non-adopting firms had not adopted the innovations in question because, among other reasons, they a). they had a preference for a second-hand and cheaper machinery (two non-adopting firms of the packaging machine) and b). were willing to tolerate the lower performance of imported competitive products on the basis of their price difference with the innovation in question (three non-adopting firms of the power supply system).

6.2.5. RESEARCH INSTRUMENT

A combination of personal interviews and structured questionnaires which were extensively pre-tested was used to collect the data from the adopting and non-adopting firms.

Although each question carries the same importance and weight, it was felt that variables for which appropriate measures existed, they could be properly investigated by a structured questionnaire which was provided to an appropriate person in the firm. Questions dealing with more qualitative data i.e. reasons of adoption, problems faced during the development or adoption, were directed to the appropriate persons by means of semi-structured questionnaires during personal interviews. To this end, four questionnaires were developed which are included in the Appendix C and are as follows: a) A structured questionnaire inquiring the environmental conditions and the internal characteristics of all participating firms, b) a semi-structured questionnaire inquiring the development and the marketing process of the innovations in question, c) two semi-structured questionnaires addressing the issues involved during the adoption and the rejection process of the innovations by adoptors and non-adoptors respectively.

The pre-testing results of the questionnaires indicated that the most appropriate person to fill them was the General Manager (or Managing Director) who was also the owner of the firm and the person that had the most crucial role in the adoption process of the innovation. Thus by the end of the first interview with the Managing Director the structured questionnaire was left to him to be filled during the following 2-3 weeks and by that time it was collected personally. In cases where this was not ready, the author arranged for additional personal interviews where the structured questionnaire was filled.

As such, the method used for collecting the data is the key informant technique. Nevertheless, it has been claimed that this method has certain weaknesses since, it "precludes a rigorous assessment of the convergent and discriminant validity of informant reports... prohibits a determination of the extent to which variation in measurements is due to (1) the concepts of interest, (2) systematic sources of error, or (3) random error" (Philips 1981,p.396).

According to Phillips (1981) the sources of errors in the key informant technique are related to the complexity of the social judgement involved, the positional bias, the job satisfaction and other characteristics of the informant, the availability of information sources and knowledge of facts by the informant, as well as, the length of time the informant has been in the organization. However, in the present case, it was felt that the potential for systematic and random sources of errors was minimised due to the following issues: 1). Small firms, in contrast with large ones, tend to be managed in a personalised fashion directly by their owner(s) who participate in all aspects of managing the business (Carson 1985). As such, they possess considerable knowledge of all aspects of their firms. 2). Due to the variety of constructs under investigation in the firms that produced the innovations in question (development, commercialization), in each case the Managing director, the Technical director and the Marketing manager were contacted and issues relative to their scope of activities were addressed to them. 3). Interviewees were asked to check facts with other company personnel, where this was considered to be necessary. 4). The combination of personal interviews and structured questionnaires for data collection, alongside multiple visits to the participating firms, yielded a high degree of researcher control in addressing the relevant issues correctly. Regarding the interviews, they were conducted during the second half of year 1989 and the minimum time spent was 2 hours per person, while in some cases it exceeded the period of 4 hours. This indicates the high response and the commitment to the research of the persons interviewed which in turn, facilitated the collection of a large amount of information.

6.2.6. MEASUREMENT OF VARIABLES

The variables were measured through a combination of interval type scales (1 to 7) and dichotomously (0/1). The interval scale (1 to 7) was intentionally kept throughout the questionnaires for reasons of consistency and in order to facilitate the respondents to the efficient use of it. This scale was modified only in two occasions where the organizational structure was measured by the scale developed by Hage and Aiken (1 to 4), and in the case of the competition assessment (1 to 5) (for a comprehensive presentation of the scales used, see table 6.1. pp 133-136).

6.2.7. STATISTICAL METHODS USED FOR DATA ANALYSIS

The statistical methods employed for the data analysis were chosen on the basis of the following criteria : 1. Research objectives i.e. identification of a relationship or strength of a relationship between two or more variables. 2. Number and type of variables involved in each analysis (for both dependent and independent variables) i.e. one or more dependent or independent variables, nominal, ordinal or interval type (Tull & Hawkins 1984, Kinnear & Taylor 1991, Blalock 1988, Siegel 1956, Green and Tull 1978). Moreover, three levels of analysis were applied i.e. univariate, bivariate and multivariate. Each of them is briefly explained as follows:

6.2.7.1 UNIVARIATE ANALYSIS

1. Frequencies of all variables in the questionnaire. This enabled an overall view of the collected data.

2. Assessment of normality of the variables. To this end the Kolmogorov - Smirnov (normal) test (a goodness of fit test) was used, to test whether the different variables distributions come from a multivariate normal distribution. The results indicated that many variables were not normally distributed. However this was expected, since the number of cases is small.

6.2.7.2 BIVARIATE ANALYSIS

The aim of the bivariate analysis was to determine whether or not there exist any of the previously hypothesised relationships between the study's independent variables and the dependent variable (adoption response). Adoption response was indicated dichotomously (0/1, where 0 : Rejection and 1 : Adoption).

Typically, four types of dependent variables have been used in adoption studies: time of adoption or delay in adoption (Baker 1975a, Abu-Ismail 1976, Bamossy et al. 1989), number of innovations adopted (Cohn & Turyn 1980, Lefebvre et al. 1991), extent of adoption (Mansfield 1968b), and adopt/not adopt (Globerman 1975, El-Sherbeny 1979, Gatignon & Robertson 1989).

As this study is concerned with factors influencing adoption response (adoption or rejection), it was felt that the grouping of firms into adoptors and non-adoptors (rejectors) was the most appropriate measure. Therefore, given the dichotomous (0/1) nature of the dependent variable, the Mann-Whitney U test, the Fisher exact probability test and the T-test were used (depending upon the measurement of each independent variable and the existence or not of normality). The measurement level of the variables tested can be assumed as interval since Likert type scales have been used (Blalock 1988). However due to the lack of normality and the small sample size in most cases the non-parametric Mann-Whitney U test was used instead of the parametric t-test. Variables which were measured dichotomously (0/1), were analysed by the use of the Fisher exact probability test.

Moreover, since two groups of firms were identified for each innovation under consideration, the statistical analysis was performed on an aggregated level (i.e. all adoptors versus all non-adoptors). Such an aggregated level of analysis can be found in many studies of innovations e.g. Rothwell et al. 1974, Peters & Venkatessan 1973, Bamossy & Eenennaam 1989, Gatignon & Robertson 1989. However, in the present study, an analysis on an innovation basis (i.e. adoptors versus non-adoptors of a specific innovation) is reported when the aggregated level was felt inappropriate (i.e. case of innovations' characteristics).

The hypothesis **Ho** is that the two samples, adoptors and non-adoptors as defined by the dependent dichotomous variable, have been drawn from the same population and the hypothesis **H1** is that they have been drawn from different populations. A significance level of 5% is used i.e. a 95% level of confidence or higher.

According to Mood (1954), Siegel (1956) and Blalock (1988) if the Mann-Whitney test is applied to data which might properly be analyzed by the most powerful parametric test, the t test, its power efficiency approaches 95.5% as N increases and is close to 95% even for moderate-sized samples. In view of the fact that it requires much weaker assumptions, it should therefore be used in instances where there is a reasonable doubt of the legitimacy of either the interval scale or normality. In addition Blalock (1988, p.202) claims that the Mann-Whitney test seems to be the most powerful of the non-parametric tests when the major differences between the two populations are with respect to central tendency.

6.2.7.2.1. ALTERNATIVE TESTS:

1. Randomization test; although applicable this test was rejected due to computational difficulties.

2. Kolmogorov-Smirnov test; use of this test produced results similar to the Mann-Whitney U test.

3. Median test; it is weaker than the Mann-Whitney U test (Siegel 1956).

4. Wald-Wolfowitz runs test; unlike other tests, this is addressed to any sort of differences (central tendency, variability, skewness) and when used by its own cannot provide sufficient information regarding the direction of the differences in the two samples. Comparative use of this test and the Mann-whitney U test was in favor of the second one (Siegel 1956) and the power-efficiency of this has been estimated to be about 75% for samples near 20 (Smith 1953).

In addition to the analysis mentioned above, which identified the existence of a relationship between the dependent variable (adoption response) and each independent variable, the Kendall's Tau correlation coefficient was used in order to investigate the strength of any identified relationship. The choice of Kendall's Tau coefficient over other parametric tests i.e. Pearson's product-moment, and non-parametric coefficients i.e. Spearman's Rho, can be justified as follows: a) According to Blalock (1988) "mounting evidence suggests that, practically speaking, it (i.e. the use of parametric or non-parametric correlation approaches) will usually make little difference with respect to one's conclusions" (p.444), b) According to Siegel (1956) both Spearman and Kendall rank order correlation coefficients utilize the same amount of information in the data, and thus both have the same power to detect the existence of association in the population, c) Kendall's tau coefficient is more meaningful than Spearman's rho in cases were the number of categories is small and the data contain a large number of ties (Nie et al. 1975).

It must be stated here that while bivariate analysis of the above type can establish the existence of a relationship and/or strength of a relationship between two variables, it cannot demonstrate the existence of causality between the two variables. According to Tull and Hawkins (1984) "association is evidence of causation but it is not proof of it" (p.514).

The conditions under which one can make causal inferences are:- a) Existence of associative or concomitant variation, b) Sequence of events and c) Absence of other possible causal factors (Green and Tull 1978, Kinnear and Taylor 1991). However, Green and Tull (1978) have postulated that "no one of the three types of evidence, nor, indeed, all three types combined, can ever demonstrate conclusively that a causal relationship exists. However, we can obtain evidence that makes it highly reasonable to conclude that a particular relationship exist" (p.74). The latter is in line with the probabilistic notion of causality i.e. the scientific notion, as opposed to the deterministic one, which specifies the effect of a relationship as being only probable (Kinnear and Taylor 1991).

With reference to marketing, Kinnear and Taylor (1991) have noticed that " the world of marketing fits the scientific view of causality. Marketing effects are probabilistically caused by multiple factors, and we can only infer a causal relationship - we can never really prove it definitely" (p.266).

Despite any difficulties in establishing causality between or among the variables of a research, it must be stated that failure to take its existence into account might lead to the identification of relationships which in fact are only spurious (Blalock 1988). Clearly, the latter may cause serious problems, especially in cases where prediction of a variable's value is attempted. To this end, experimental designs and simultaneous equation techniques have been proposed for dealing with the issue of causality (Green & Tull 1978, Kinnear & Taylor 1991, Blalock 1988).

However, in the present research, it was felt that the problem of causality was not a major one owing to the following reasons:

a) The independent variables of the research have been produced by means of an extensive literature review which has justified the existence of a logical linkage between them and the dependent variable employed i.e. adoption response. Similarly, Blalock (1988) has postulated that "If our theory is able to show a logical connection between the two variables...we need not to be too unhappy about making the intellectual leap to a causal interpretation" (p.469).

b) The statements of the study's hypotheses incorporate the probabilistic notion of causality (for example the hypothesis No. 1 of the study states that : the faster, it is perceived by a firm, the entry rate of new firms in its industry, the more likely it is that firm to have a positive adoption response towards innovation).

c) Finally, the purpose of the present study is not to predict the adoption response of firms to technological innovation. Rather, the research attempts to describe and explore the adoption response by means of an integrated conceptual framework. This, alongside other methodological steps followed in the study, was expected to illuminate further the reasons underlying any relation-ships. The latter may be found useful in the future by researchers attempting to quantify the direction of any hypothesised relationship (Baker 1991) of the variables documented in the present study.

6.2.7.3. MULTIVARIATE ANALYSIS

Multivariate analysis was used here, to investigate the existence of a combination of independent variables that could discriminate effectively firms in this study as either adoptors or non-adoptors of technological innovation. To this end the categorical nature of the single dependent variable (adoption response) dictated the use of discriminant analysis (Kinnear & Taylor 1991). Moreover, due to the small number of cases in the study and the lack of normality in most of the independent variables involved, the discriminant results were validated as follows (for a more detailed presentation of the properties of discriminant analysis see section 7.7 and Appendix E).

1. *Which independent variables are good discriminators?* To this end the following techniques were used: a) The conditional deletion method, as proposed by R.A.Eisenbeis (1977), b). Normalization of the standardized discriminant coefficients, as proposed by D.G.Morrison (1969), c). Assessment of the stability of the discriminant coefficients. To this end, a 'Jackknife' approach was used which has been proposed by Crask & Perreault (1977).

2. *How well do the variables discriminate among groups?* To this end the the classification error rates were assessed by the U method proposed by Lachenbruch & Mickey (1968).

Armed with the above insights, the next chapter will examine the data obtained in the field work of this study as well as the results from the statistical analyses of these data.

CHAPTER SEVEN

ANALYSIS OF THE FIELD STUDY FINDINGS

7.1. INTRODUCTION

This chapter is divided into seven sections which provide a detailed presentation, analysis and discussion of the data collected from the field.

Briefly, ***Section 7.1*** investigates the reasons for adoption or rejection of each innovation and explores any similarities or differences among adoptors and non-adoptors.

Section 7.2, establishes from a descriptive point of view the link among specific development and marketing activities of the innovations' suppliers and reasons for adoption or rejection of these innovations, as they have been stated in the previous section.

Section 7.3, examines the link between adoption response (adoption or rejection) and information provided by suppliers, perceived characteristics of innovations and risk perceived in the adoption decision.

Section 7.4, identifies which of the industry specific factors have influenced the adoption response of firms in our sample.

Section 7.5, investigates the influence upon adoption response of factors related to the production process and the products of firms.

Section 7.6, examines specific organizational and managerial aspects of the firms, and assesses their influence in the decision of firms to adopt or reject an innovation.

Finally, ***Section 7.7***, is an attempt to develop a 'profile' of firms that could distinguish adoptors from non-adoptors in the sample of this study and as such, to assess the collective influence of the many factors impinging upon the decision of firms to adopt or not an innovation. To this end discriminant analysis is used.

Each of the above sections examines the validity of specific hypotheses by means of either the Mann-Whitney U test or the t-test. Results are indicated in tables which embrace the following:

1. The mean rank scores of each independent variable for adoptors and non-adoptors. When the t-test is applied the actual means are reported instead.

2. The number of cases i.e. adoptors, non-adoptors that have been taken into account for each test.

3. The U coefficient of the Mann-Whitney's test, and the level of its significance after it is corrected for ties. For the t-test the t coefficient and its significance are reported.

4. In addition for the t-test, a comparison is made between the two groups (adoptors and non-adoptors) regarding their variance equality. To this end the F test is reported and, depending upon its significance, the pooled or the separate estimate of the t-test is employed.

Moreover signs used in each table indicate the following:

(*V) : the relationship accords with the hypothesis significantly,

(V) : the relationship supports the hypothesis but not significantly,

(X) : the relationship does not support the hypothesis.

Section 7.1. : REASONS FOR ADOPTION OR REJECTION AS PERCEIVED BY ADOPTORS AND NON-ADOPTORS

7.1.1. INTRODUCTION

The vast majority of studies on the adoption of innovations follow a pure quantitative approach and call respondents to comment on issues affecting the adoption of innovations as they have been identified by past research. Such an approach while useful for generalising results is incapable of identifying issues particular to specific situations.

On the basis of the above argument, it was decided to allow respondents to express in their own words the reasons on which they attribute the adoption or rejection of each innovation. To this end respondents were asked, at the beginning of their interview, to state why they have adopted or rejected each innovation. The underlying methodological objective of this early question was to avoid the use of 'check-lists' of reasons which are capable of leading the respondent to a normative way of thinking instead of his own real one. To this end this part of the research can be characterised as highly exploratory. As such, the results relating to these issues will be presented as follows.

a. Reasons for adoption or rejection of innovation No.1 (CNC BENDING MACHINE) as perceived by its adoptors and non-adoptors.
b. Reasons for adoption or rejection of innovation No.2 (PACKAGING MACHINE) as perceived by its adoptors and non-adoptors.
c. Reasons for adoption or rejection of innovation No.3 (POWER SUPPLY SYSTEM) as perceived by its adoptors and non-adoptors.

In order to have an overall picture of the reasons mentioned by the respondent in each firm and in order to facilitate comparisons among firms cross-tables have been constructed which illustrate the following:

1. The reasons for adoption or rejection. 2. The participating firms, which are represented by numbers.

When a reason has been mentioned by a firm the symbol (X) is used to indicate it, and an empty cell is left when the reason has not been mentioned by that firm. Furthermore in the discussion that follows each cross-table a number of symbols are used which indicate the following:

(A1,A2,...A6): Each adopting firm of innovation No.1
(NA1,NA2,...NA4): Each non-adopting firm of innov. No.1
(B1,B2,...B6): Each adopting firm of innovation No.2
(NB1,NB2,...NB4): Each non-adopting firm of innov. No.2
(C1,C2,...C5): Each adopting firm of innovation No.3
(NC1,NC2,...NC4): Each non-adopting firm of innov. No.3

7.1.2. REASONS FOR ADOPTION OR REJECTION OF INNOVATION No.1 (CNC BENDING MACHINE) AS PERCEIVED BY ITS ADOPTORS AND NON-ADOPTORS

The following table 7.1. indicates that there is not a single reason on which one can attribute the adoption or rejection decision. Moreover, this table suggests that the decision to reject an innovation, as an alternative outcome of the adoption decision making process, is as complex as the decision to adopt the innovation.

Table 7.1. : Reasons for adoption & rejection of innovation No.1

	REASONS FOR ADOPTION	ADOPTERS					
	FIRMS	1	2	3	4	5	6
a.	Increasing production needs	X	X	X	X	X	X
b.	Bring down labour needs	X	X	X		X	X
c.	Meet competition in delivery time	X	X	X	X		X
d.	Meet competition in quality	X	X	X	X		
e.	Accuracy in production	X	X		X	X	
f.	Introduce new material		X	X			
g.	Better utilization of rest equipment	X					
h.	Be independent from suppliers	X					
i.	Gain flexibility in production	X					

	REASONS FOR REJECTION	NON-ADOPTERS			
	FIRMS	1	2	3	4
j.	Negative information for the supplier				
1	Regarding collaboration with customers		X	X	X
2	Regarding innovation's performance		X	X	X
k.	Decreasing production needs			X	X
l.	Need for buying other costly machinery	X	X		
m.	Confusion from source loyalty	X			

However, closer and more careful inspection of table 7.1. reveals a kind of 'sensible' complexity in the reasons of adoption or rejection. Indeed, regarding adoptors, in the question why they have adopted the innovation, they all started their statements as follows: 'we wanted to increase our production capacity but at the same time we wanted to keep our costs down and increase the quality of our products'. Although this might sound as a permanent and elusive objective of every industrial firm, further questioning and focusing on the specific innovation revealed the following.

Increasing demand for spring mattresses both domestically and abroad created a need to individual firms for increasing their production as well as the opportunity for exports. The latter as well as the successful performance of these firms in the domestic market were mainly based upon the cost advantage of Greek firms which in turn can be attributed to the lower labour cost in Greece than abroad. However as it was explained by respondents in five firms (A1, A2, A3, A5, A6) the prospective 1992 EEC unification had created expectations for rising labour costs in Greece and therefore, any attempt to increase production had to take into account increases in labour cost. In this respect, the innovation in question was most appropriate since it enabled firms not only to increase their production of frames but also to disengage from the process one of the two workers previously needed to produce the frames. However, as it was explained by respondents in all adopting firms, the disengaged workers were not dismissed but instead were absorbed in other parts of the production process within the firm.

In addition increasing demand and use of spring mattresses resulted in more knowledgeable end customers who in turn became more demanding regarding the quality of the mattress and the time needed to be delivered to them, especially when they wanted a custom-made mattress. Moreover increasing demand combined with the inability of the established firms to raise their production immediately, acted as an opportunity for the establishment of new firms which were either importing firms or firms producing parts of the mattresses to be used by other firms. These conditions created competition in quality and delivery services among firms delivering mattresses to the end customer. Similarly, derived demand resulted in the same types of competition among firms producing and selling frames to be used by other firms in their production of spring mattresses. Again the innovation was the most appropriate since its production capacity created savings in production time and successively in delivery time. Regarding quality, four firms (A1,A2,A4,A5) mentioned the accuracy of the machine in producing similar sizes of frames or according to specifications which alongside its speed in production seem to be the most distinguished characteristics of the innovation from the adoptors point of view.

Interestingly one firm (A1) mentioned, among other, the need to become independent from suppliers as a reason for the adoption of the innovation. To this end it was explained that in the past the firm had faced difficulties with its frame suppliers regarding the quality of the frames and the time of their delivery in the firm. The innovation enabled the firm to substitute a large amount of supplies with its own production and to have full control in the quality of the frames produced.

Finally in two firms (A2,A3) the adoption of the innovation was connected with the introduction of a new material (round wire instead of the previously used flat wire). As it was explained the new material was produced in Greece and therefore it was cheaper than the flat wire which was imported. Both firms were anticipating large orders both domestically and abroad and the need to have the production capacity in order to capture the market before the appearance of imitators necessitated the adoption of the innovation.

A classification of the above reasons on the basis of the conceptual framework employed in this study produced the following clusters:

1. Firm specific reasons relevant to:
   a) Production (a,b,g,h,i)
   b) Products (f)
2. Industry specific reasons (c,d)
3. Innovation specific reasons (e)

Furthermore table 7.1. indicates that in terms of agreement among firms, five reasons (a,b,c,d,e) have been stated by more than 50% of the adopting firms.

Regarding non-adoptors, respondents in two firms (NA3,NA4) stated that during the recent years their sales have fallen mainly due to the competition from both Greek manufacturing firms and importing firms. More specifically they attributed their bad performance to the better selling efforts of the rival firms rather than to the quality of the products. An immediate result of their decreasing sales was a cut to their production output which became easily managed by their currently employed machinery & equipment and labour force. Another result of their bad performance was financial difficulties in sustaining their business. Their bad performance was regarded by them both as a financial constraint in buying the innovation and as an anti-incentive in attempting to increase the production's output when it was doubtful that they could sell it. According to their statements, in their attempts to improve their results they considered seriously the adoption of the innovation. However their decision to reject it was enhanced by the fact that when they approached an already adoptor, in order to get information for evaluating the innovation, they received negative information regarding both its supplier and its performance. Despite any reluctance in revealing their sources they finally admitted that this firm was the adoptor (A2) in table 7.1. This firm is the one that initiated the development of the innovation and which has faced many problems both with the supplier and the use of the innovation. On the question of whether they have approached other firms, respondents in both firms answered negatively and based it on the fact that due to their past collaboration with the owner of the previously mentioned firm they were regarding his opinion as trustworthy.

Negative information was also mentioned by firm (NA2) where in spite of considerable efforts their source was not revealed. In addition firm (NA2) as well as firm (NA1) mentioned that at the time when they became informed of the innovation they were considering the adoption of other costly machinery. More specifically, both firms were considering the adoption of a spring machine which according to their statements is the most important and the most expensive piece of machinery in their production process (almost ten times more expensive than the innovation in question). Therefore, all their efforts and financial resources were devoted to this machine which in turn was acting as a constraint in any attempt of adopting the innovation in question.

These two reasons (negative information and need for buying an expensive machine) revealed a distinctive pattern of reasons for rejection. An obvious question is whether these very same reasons have been taken into account by adoptors. Regarding negative information it was found that firm (A1) adopted the innovation almost at the same time as firm (A2) (i.e. the one spreading negative information), and therefore they did not consult any other firm. Similarly firms (A5 & A6) visited firm (A1) to inspect the innovation and had no relationships with firm (A2). Finally, the owners of firms (A3 & A4) mentioned that although they had close relationships with firm (A2) and that they were aware of any problems they also visited firm (A1) where no problems either with the innovation or the supplier were detected. In addition, they claimed that their machines were more advanced than the previous ones and that the supplier had created an impression to them of an entrepreneur who has taken considerable steps in correcting previous mistakes. Regarding the need for buying a more expensive machine all adopting firms mentioned in a follow-up interview that they had no such need. However they all indicated that such a need might have delayed the adoption of this innovation for some time.

It is interesting to note that a kind of confusion regarding the source (supplier) of the innovation was realised from the personal interviews in firm NA1. The owner of this firm found the innovation in an international trade show in the kiosk of the Swiss firm which had acquired the innovation through licensing from the Greek firm. Although his visit was made for buying a spring machine from this Swiss firm, he expressed his interest for the innovation in question and made many questions regarding its technical characteristics. However, it was not explained to him that since his firm was in Greece, he had to buy the innovation from the Greek firm which has originally produced it. His confusion was increased by the fact that when he received further information about the machine they were sent, in contrast with his expectations, by the Greek firm instead of the Swiss firm. He concluded that because he was absorbed with the adoption of the spring machine, he did not make any further enquiries, rather he waited to learn more about it by the representative of the Swiss firm in Greece with whom he had very good relationships. Since the representative did not mention at all the innovation to him he concluded that it was not worth of further investigation and his interest evaporated.

Again, a classification of the above reasons on the basis of the conceptual framework employed produced the following clusters:

1. Firm specific reasons relevant to:
   a) Production (k,l)
2. Supplier specific reasons (j1,m)
3. Innovation specific reasons (j2)

In terms of agreement among firms, four reasons (j1,j2,k,l) have been stated by 50% or more of the non-adopting firms.

7.1.3. REASONS FOR ADOPTION OR REJECTION OF INNOVATION No.2 (PACKAGING MACHINE) AS PERCEIVED BY ITS ADOPTORS AND NON-ADOPTORS.

Table 7.2 illustrates the reasons for adoption or rejection of the PACKAGING MACHINE as they have been stated by its adoptors and non-adoptors. Inspection of this table indicates that all the adoptors of the packaging machine, similar to the adoptors of the wire bending machine, were facing increasing production needs. As it was explained by respondents in all adopting firms the latter was dictated by an increasing demand from the consumers for packaged products.

More specifically, for firms (B1 & B2), each of which is associated with a large retailing firm in Greece, this demand was expressed directly by their customers preferences while for the remaining adopting firms, which were wholesalers, it was the derived demand through the retailing firms that has necessitated increases in production. To this end the innovation was most appropriate since as it was explained by respondents in all firms the currently employed machinery (other packaging machines) had reached their limits and further increases in production could only be achieved through the use of new machinery or the employment of a large number of workers. However, it was added that due to the increasing labour cost they wanted to avoid employing new workers both presently and in the future.

Regarding labour, table 7.2. indicates that five firms have explicitly mentioned the need to reduce their future labour needs as a reason for adopting the innovation. To this end it was found that after the adoption of the innovation, disengaged workers were reallocated within firms (B1,B2,B3, B4) while in firm (B5) three unskilled workers were dismissed.

Furthermore, respondents in all adopting firms indicated that alongside the need to increase production, their firms were facing the need to introduce new packaging methods and packaging materials for their products. The latter was regarded by all firms as essential for facing competition and a major reason for adopting the innovation.

The remaining reasons illustrated in table 7.2. indicate that characteristics of the supplier and the innovation played also an important role in the adoption of the innovation. Regarding the supplier, firms (B1,B2,B3,B5,B6) mentioned the quick and direct service provided by him. As it was mentioned by respondents in these firms due to the heavy use of the packaging machines in their production process they often break down and immediate technical assistance is necessary. In addition regular service is necessary for expanding the operational life of these machines. To this end firms (B1,B2,B3) mentioned that they have faced problems with breakdowns of other imported packaging machines since the geographical distance of the supplier delayed the repair of them.

Table 7.2. : Reasons for adoption & rejection of innovation No.2

	REASONS FOR ADOPTION	ADOPTERS					
	FIRMS	1	2	3	4	5	6
a.	Increasing production needs	X	X	X	X	X	X
b.	Introduction of new packaging	X	X	X	X	X	X
c.	Bring down labour needs	X	X	X	X	X	
d.	Quick and direct service	X	X	X		X	X
e.	Understanding of technology	X	X	X	X		
f.	Price compared to other machines	X		X	X		X
g.	Modifications to fit production needs					X	X
h.	The Greek origin of the firm	X					
i.	Existence of spare parts			X			

	REASONS FOR REJECTION	NON-ADOPTERS			
	FIRMS	1	2	3	4
j.	Need for a more flexible machine		X	X	X
k.	Suspicious with Greek suppliers	X	X	X	
l.	Uncertainty regarding sales volume and thus, need for a used and cheaper machine			X	X
m.	Expectations for large orders and thus, need for higher speed	X			
n.	Better financial terms from foreign firm	X			
o.	Contract packaging as an alternative				X
p.	Expectations for new EEC directives		X		

Another reason, related to the service provided by the supplier, is the understanding of the innovation's technology and this was mentioned by firms (B1,B2,B3,B4). Indeed, on the question of why the understanding of technology was among the reasons for adoption respondents from the above four firms stated that in this way they could take actions by themselves in correcting immediately any breakdowns of the machine. They added that this was providing them a feeling of independence from the supplier. Trying to get more information on this issue, it was found that firms (B1,B2) were also employing technicians for dealing immediately with any problems of their packaging machines in operation. Although firms (B3,B4) did not have such technicians, it was found that their owners had developed an ability through experience in dealing with machines' breakdowns. More specifically, the owner of firm (B4) stated that 'we know our packaging machines so well that in case of breakdowns we are capable of detecting what went wrong and therefore we can either correct it by ourselves or dismantle the fault parts so as when the servicing technician from the supplier comes he can correct it as soon as possible'.

In addition, two firms (B5,B6) stated among other reasons for adoption the fact that the supplier modified the packaging machine so as to fit their production needs. Respondents in these firms indicated that they could not find packaging machines specifically for their products and therefore, they had to ask for modifications of existed ones. However, foreign manufacturers were not only unwilling to help but also, were asking high premium prices for such changes. The supplier in question however, did this with only a very small increase in the cost of the machine.

Finally, the selling price of the packaging machine was indicated by three firms (B1,B3,B4) as a reason for adoption. Respondents in these firms explained that the price of alternative imported machines (same speed of packaging) was almost double than the one in question. However, they all mentioned that imported packaging machines with higher speeds could be found, but the speed increase was not that much to justify the enormous additional cost.

A classification of the above reasons on the basis of the conceptual framework employed produced the following clusters:

1. Firm specific reasons relevant to:
   a) Production (a,c)
   b) Products (b)
2. Supply specific reasons relevant to:
   a) Supplier (d,g,i)
   b) Industry (h)
3. Innovation specific reasons (e,f)

In terms of agreement among firms, six reasons (a,b,c,d,e,f) have been stated by 50% or more of the adopting firms.

Regarding the reasons for rejection, in one firm (NB1) it was mentioned that they had bad experience in the past with Greek suppliers of other machinery and therefore, they feared that they were going to have similar problems. In addition, it was explained that, due to their introduction of a new product they expected large orders which could not be performed because of the speed limits of the innovation in question. To this end, it was found that the supplier of the innovation offered to this firm two packaging machines so as to satisfy the speed requirements. However, as the owner of the firm explained, although the price of the two Greek machines was lower than the imported, he rejected them because of the lack of space in his firm and the good financial terms for the repayment of the machine offered by the foreign firm.

The remaining three non-adopters (NB2,NB3,NB4) mentioned that they rejected the innovation because they were looking for a more flexible machine capable of packaging different kinds of their products. In addition firms (NB2,NB3) mentioned that their decision was influenced by their bad past experience with Greek suppliers. Moreover, the owner of firm (NB2) stated the fact the he was expecting the announcement of a new severe EEC directive for the packaging safety conditions of agricultural pharmaceutical products and he was not sure that the packaging machine in question was fully in accordance with them. Finally, firms (NB3,NB4) mentioned the fact that since they were attempting packaging their product for the first time, they were unable to anticipate sales volumes and thus they were oriented towards the buying of a used and cheaper packaging machine, a kind of secured trial for the first steps. To this end, firm (NB4) mentioned also the alternative contract packaging of its products as a reason for rejecting the innovation. However, the owners of these two firms explained that, provided their sales will reach a sufficient volume, they will consider seriously again the adoption of the innovation.

A classification of the above reasons on the basis of the conceptual framework employed produced the following clusters:

1. Firm specific reasons relevant to:
   a) Organizational/managerial issues (l,m,)
2. Industry specific reasons (p)
3. Supply specific reasons relevant to:
   a) Supplier (n,o)
   b) Industry (k)
4. Innovation specific reasons (j)

Furthermore, in terms of agreement among firms, three reasons (j,k,l) have been stated by 50% or more of the non-adopting firms.

7.1.4. REASONS FOR ADOPTION OR REJECTION OF INNOVATION No.3 (POWER SUPPLY SYSTEM) AS PERCEIVED BY ITS ADOPTORS AND NON-ADOPTORS

The following table 7.3 illustrates the reasons for adoption or rejection of the POWER SUPPLY SYSTEM.

Table 7.3. : Reasons for adoption & rejection of innovation No.3

	REASONS FOR ADOPTION	ADOPTERS				
	FIRMS	1	2	3	4	5
a.	Good collaboration with the supplier	X	X	X	X	X
b.	The technology itself	X	X	X	X	X
c.	Increasing production needs	X	X	X		X
d.	Introduction of new product Greek added value	X	X	X	X	X
	Incorporate new technology	X	X	X	X	
e.	Price as compared to imported	X		X		X
f.	Quality of design		X	X		
g.	The Greek origin and small firm's size	X		X	X	

	REASONS FOR REJECTION	NON-ADOPTERS			
	FIRMS	1	2	3	4
h.	Fears for future existence of supplier	X	X	X	X
i.	Price as compared to imported	X	X	X	
j.	Introduction of new product and thus, heavily occupied with other issues			X	X
k.	Low production and thus, own development	X			

Although the innovation in question is a component and not a machine-tool like the previous innovations, again increasing production needs have been cited by firms (C1,C2,C3,C5) as a reason for its adoption. As it was explained by respondents in these firms, when their sales volume and thus production was low and concentrated in few products they were able to manufacture their own power supply systems. However, increases in their product range and sales volume created the need for the development and production of different power supply systems. Thus, they found themselves engaged in a process which was not only time- and resources consuming, but also one in which they had no expertise. As it was explained by respondents in all these firms, in order to overcome this problem they had two alternatives: they could either buy ready made imported power supply systems or they could collaborate with a foreign or Greek firm for the development of one according to their specifications. The decision to favour a Greek supplier was attributed to the technology of the innovation in question as well as to the good collaboration with its supplier.

Regarding the good collaboration with the Greek supplier all firms mentioned that it was assessed during the first meetings they had with him. As they explained, the R&D efforts of the firm as well as its technological base and expertise alongside the promptness of its owners in responding immediately on every enquiry created to them an image of a firm worthy of being trusted. Respondents in all adopting firms added that this was very important since the decision to collaborate with this firm meant 'a permanent engagement' between supplier and adoptors.

Regarding the innovation and its technology all firms stated that it was of high standards similar to the ones employed by leading European and American companies. Other reasons related to the innovation's characteristics, were its price as compared to imported ones (C1,C3,C5) and its high quality of design (C2,C3).

Furthermore, as it is indicated from table 7.3. in five firms the adoption of the innovation was connected with the development of a new product. As it was explained by respondents in firms (C1,C2,C3,C4) since they were attempting the development of a technologically advanced product it was necessary for its power supply system to be of high technology too since it is a very important part of their products. In addition, in firms (C1,C2,C3,C4,C5) it was mentioned that sales of their new products were oriented to the public sector where due to Greek legislation the more the Greek added value of a product the more its odds to be purchased by Greek public firms. To this end, the Greek origin of the innovation was adding substantially to the Greek added value of their products and that was also an important reason for its adoption. Moreover, firms (C1,C3,C4) mentioned that the Greek origin and the small size of the supplier was another reason for their adoption decision since a) geographical proximity and use of common language was facilitating their communication, b) the supplier and his efforts were respected by the adoptors since they perceived him as an image of their own early steps and efforts in Greece and therefore, they not only trusted him but also wanted to help by favouring him over foreign firms and c) the supplier was at his early stages of growth and therefore they knew that although their orders were small they were going to receive good attention by him since from their own experience they realised that at these early stages of a firm, every account is important and the same view was held by the supplier himself.

Classifying the above reasons on the basis of the conceptual framework employed the following clusters were produced:

1. Firm specific reasons relevant to:
   a) Production (c)
   b) Products (d)
2. Supplier specific reasons (a,g)
3. Innovation specific reasons (b,e,f)

In terms of agreement among firms, four reasons (a,b,c,d) have been stated by 50% or more of the adopting firms.

Regarding the reasons for rejection table 7.3. indicates that all four non-adoptors expressed as a reason for rejection their fears for the future existence of the supplier. As respondents in these firms explained, the power supply system is an important part of their products and its specifications (i.e. power output, efficiency, dimensions) are decided on the basis of the overall product operational needs. Therefore, the degree of integrity between the product and its power supply system is such that replacement of an existing supply system means enormous expenses. However the fact that the Greek supplier was small in size and he was operating in a high technology area while in the hostile Greek industrial environment, was regarded by non-adoptors as of high propensity to failure in the future. This in turn, was increasing their beliefs that, if they accept the innovation they might have to replace it in the future in case that the firm would have failed.

It is of great interest here to note the contradiction between the perceptions of adoptors and non-adoptors regarding the effect of the small size of the supplier firm in their decision to adopt or reject the innovation. In order to highlight the issue, respondents in adopting firms (C1,C3,C4) were contacted by phone and they were asked to comment on this contradiction. They replied that they indeed considered the future existence of the supplier however, they repeated their statements mentioned above and they added that their own good performance and thus, their orders to the supplier was a kind of insurance that the supplier will be able to survive in the future.

Another reason for rejection mentioned by three firms (NC1,NC2,NC3) was the higher price of the innovation relative to imported power supply systems. As it was found, non-adopters had considered the adoption of supply systems from countries such as Taiwan and were willing to tolerate the lower performance of these systems on the basis of their price difference with the innovation in question. However as it was found firm (NC1) had a small production and thus it continued to produce by itself the supply systems needed for its products. In addition firms (NC3,NC4) mentioned that they were developing a new product and thus they were heavily occupied with it and had no time to decide for the power supply system.

Again classification of these reason of rejection on the basis of the conceptual framework developed in this thesis results in the following clusters:

1. Firm specific reasons relevant to:
   a) Production (k)
   b) Products (j)
2. Supplier specific reasons (h)
3. Innovation specific reasons (i)

Finally in terms of agreement among firms, three reasons (i,j,k) have been stated by 50% or more of the non-adopting firms.

7.1.5. A COMPARISON OF THE REASONS FOR ADOPTION OR REJECTION AS PERCEIVED BY ADOPTORS & NON-ADOPTORS OF ALL INNOVATIONS.

The following table 7.4. illustrates the reasons for adoption or rejection on which agreement exist among adoptors and among non-adoptors of each innovation (i.e. each reason has been cited by 50% or more of the firms).

A first overall inspection of this table indicates that reasons of adoption are not exactly the opposite of the reasons of rejection as one might have expected. This provides more strength to the Robertson and Gatignon's suggestion that many insights of the adoption process can be gained if reasons for rejection are treated as different to the reasons for adoption. More careful inspection of table 7.4. both vertically and horizontally provides a first order visual representation of the similarities and differences among: a) adoptors and non-adoptors of each innovation, b) adoptors of different innovation, and c) non-adoptors of different innovations. Starting with the horizontal comparisons the following conclusions can be made:

A. *Regarding adoptors*

Agreement exists among all adoptors regarding reasons related to production (2,3) and innovation characteristics (6,7,8,9). However, these reasons are not identical for each group of adoptors. Any differences can be attributed to the different properties of each innovation as well as to the different needs of firms from different industries. To this end, lack of emphasis to labour needs from adoptors of innovation No.3, can be explained by the fact that innovation No.1 & No.2 are productive machine tools capable of substituting labour in production while innovation No.3 is a component.

Similarly, lack of emphasis on the price of the innovation by adoptors of innovation No.1 can be explained by the fact that, no substitute innovations existed on which price comparisons could have been made.

Again, while adoptors of innovation No.1 concentrate on its accuracy in production, a response to their production needs, adoptors of innovations No.2 and No.3 concentrate on the technology however, for different reasons. In the case of innovation No.2, frequent breakdowns of their packaging machines created to the adoptors the need to understand the technology so as to be able to take corrective actions by themselves; whereas in the case of innovation No.3 its technology is compared with that of alternative innovations and can be justified upon the technical knowledge on electronics of the adopting firms.

Table 7.4. : A Comparison of Reasons for Adoption or Rejection

	Reasons for adoption	**Innovation No. 1**						**Innovation No. 2**						**Innovation No. 3**				
	Firms	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5
1	Competition	X	X	X	X		X											
2	Increasing production needs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
3	Bring down labour needs	X	X	X		X	X	X	X	X	X	X						
4	Introduction of new packaging							X	X	X	X	X	X					
5	Introduction of new product													X	X	X	X	X
6	Accuracy in production	X	X		X	X												
7	Price of innovation							X		X	X			X		X		X
8	Understanding of technology							X	X	X	X							
9	The technology itself													X	X	X	X	X
10	Quick and direct service							X	X	X		X	X					
11	Good collaboration with supplier													X	X	X	X	X

	Reasons for Rejection												
	Firms	1	2	3	4	1	2	3	4	1	2	3	4
12	Decreasing production needs			X	X								
13	Need for buying other costly machinery	X	X										
14	Introduction of new product and thus, heavily occupied with other issues											X	X
15	Uncertainty regarding sales volume and thus, need for a used & cheaper machine							X	X				
16	Need for a more flexible machine						X	X	X				
17	Price compared to imported									X	X	X	
18	Negative information for supplier												
	a. Regarding collaboration with customers		X	X	X								
	b. Regarding innovation's performance		X	X	X								
19	Suspicious with Greek suppliers					X	X	X					
20	Fears for future existence of supplier									X	X	X	X

Agreement also exists among adoptors of innovations No.2 and No.3 regarding reasons related to the supplier (10,11). Again, lack of emphasis to the supplier by the adoptors of innovation No.1 can be attributed to the fact that the innovation is supplied only by one firm and therefore comparisons can not be made. Similarly regarding the reasons related to the products of the adopting firms (4,5), innovation No.1 is not connected with a need for producing a new product and therefore, the lack of reference to these reasons by its adoptors.

Finally, it is interesting to note that competitive forces as a reason for adoption indicates a high degree of agreement only among adoptors of innovation No.1. However this is not to conclude that competitive forces were of no importance in the adoption of the remaining innovations. Indeed, as it was mentioned in the previous analysis, adoptors of innovations No.2 & No.3 made references to the competitive forces of their immediate environment. However instead of concentrating on the environment they pointed out the effects of it on their production process and their products which in turn were presented as the actual reasons for adoption. A possible explanation for this can be that adoptors concentrated on the actual benefits to be gained by the adoption of the innovations without reference to the reasons that mediated the need for the achievement of such benefits.

B. ***Regarding non-adoptors***

Horizontal inspection of the second part of table 7.4. indicates that agreement among non-adoptors exists regarding factors related to the suppliers of the innovations. However as it is obvious, these reasons are addressing different issues of the supplier and their mediating sources or events are different too. Furthermore, the majority of the non-adoptors referred to specific characteristics of the innovations as reasons for rejecting them. Again different characteristics have been cited by non-adoptors of different innovations which in turn represent their different points of interest.

Finally vertical inspection of table 7.4. indicates that some reasons which have been cited from adoptors in their adoption decision have also been accounted by non-adoptors in their rejection decision. However, with the exception of increasing-decreasing production needs these reasons are not exactly the opposite of each other as one might have expected. Indeed, while the introduction of a new product was presented as a reason for adoption by adoptors of innovation No.3 on the ground that it necessitated the use of high technology components, the same event led to the rejection of the innovation by non-adopters since they were heavily involved with other developmental issues. Again while adoptors of innovation No.3 stated that its price was lower than that of similar imported innovations non-adoptors found its price higher because their point of reference when making comparisons was different (European and US generated power supply systems for the adoptors while Taiwan generated for the non-adoptors). This in turn is a clear indication that the same events (factors) might exercise a different influence on adoption depending upon the way in which these events are realised in different firms.

7.1.6. CONCLUDING REMARKS

The analysis presented above has revealed the reasons for adoption or rejection as perceived by adoptors and non-adoptors of the three innovations in question. Furthermore comparisons among adoptors and non-adoptors have revealed important differences and similarities in their motives.

In brief, this analysis has highlighted a number of important issues for the theory of the adoption of innovations.

Firstly, supply side factors have played an important role both in the adoption and rejection process of the innovations in question. In addition, results indicate that supply side factors are evident more strongly within the frame of reasons for rejection than within the frame of reasons for adoption. To this end, the previous analysis has shown that reasons related to the suppliers have been cited more frequently by non-adoptors than by adoptors. As it was reported in chapter 2, scholars in industrial buying behaviour have acknowledged the role of supply - related factors as "hygiene" factors. However, these factors were taken into consideration only at the final stage of the industrial adoption process, i.e. the supplier selection stage. In contrast with studies in the past, the present results indicate that supply related factors have influenced the adoption response, especially of the non-adoptors, at the very early stages of the adoption process i.e. awareness and interest formulation. More specifically, it seems that negative information for suppliers, suspicion with Greek suppliers in general and fears for their future existence, have created a negative attitude or feelings of distrust among non-adoptors which eventually, influenced negatively the innovations' evaluation process and their final adoption decision. Indeed, in the case of early adoptors or the early stages of an innovation's diffusion, while it is difficult for potential adoptors to seek information in detail for the innovative product, it is easier to get information about the innovating firm (supplier) (from sources other than the supplier itself). To this end, our data indicate that in some firms, supplier information create, among other things, perceptions and expectations which mediate behaviour both in terms of which innovations will be considered for further evaluation and in terms of positive or negative inclination towards specific innovations. The latter adds strength to the argument that any attempt to understand the adoption of innovation is incomplete unless the supply-side is taken into account.

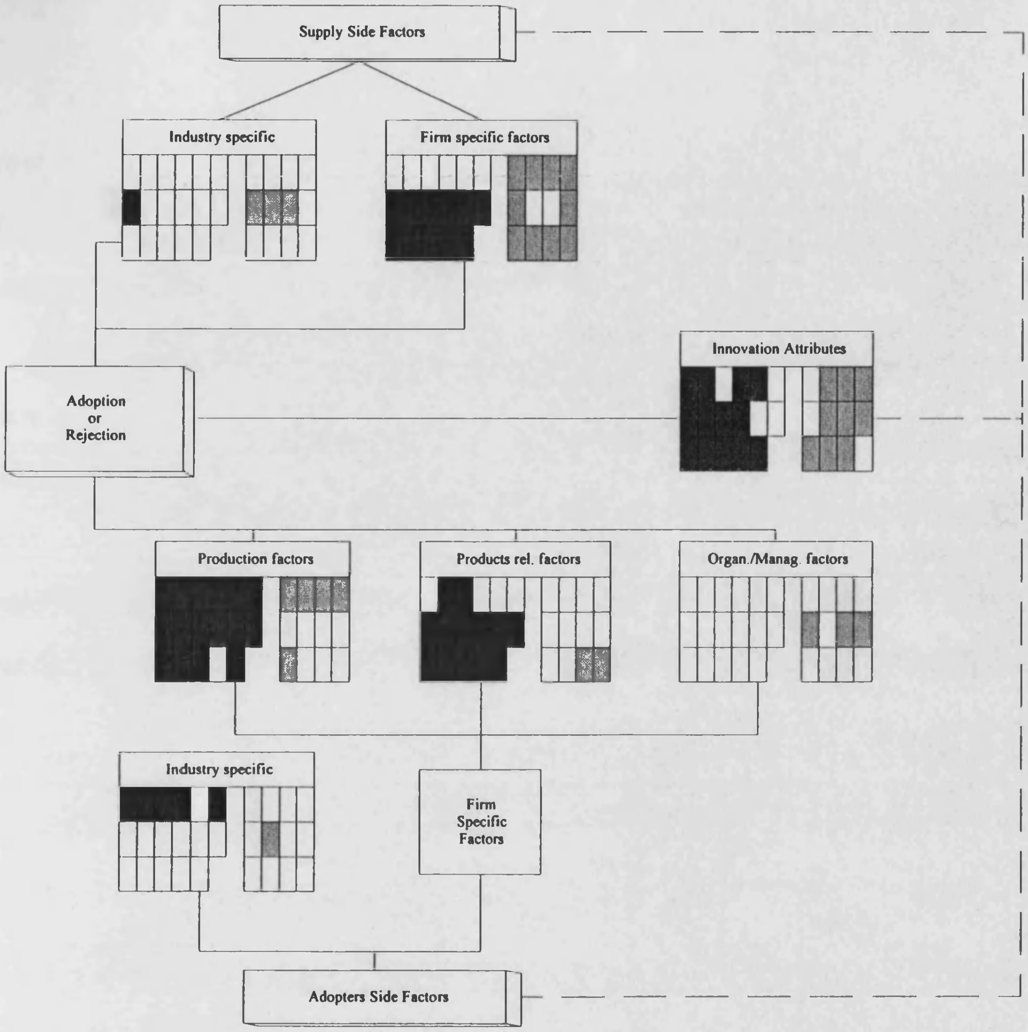
Secondly, thirteen (13) out of seventeen (17) adoptors of the innovations mentioned as a reason for adoption the fact that the innovation was compatible with the needs of their new product development programme (i.e. use of a new material (use of round steel wire in 2 cases and use of new packaging in 6 cases) and introduction of a new product (5 cases). This is in accordance with Johne's (1984a) suggestions that the product innovation practices of potential adoptors have an influence on their buying patterns. However, it is interesting to note that in the case of the Power Supply System (Innov. No. 3) all adoptors referred to the fact that this component was adding to the Greek added value of their new products which in turn was a crucial factor in their attempts to sell their products in the Greek public sector. This is a clear indication that innovations are adopted not simply because of their technical/functional tangible characteristics. Rather, intangible characteristics of the innovation are taken into account too. In the present case these characteristics reflect the expectations of the adopting firms with regard to their market arena. In other words, the power supply component is not adopted to provide a technical solution only but also to fulfil more complex and less tangible needs of the adopting unit.

Thirdly, any attempt towards finding a homogeneous set of adoption or rejection factors can be successful and meaningful only on an aggregate level, i.e. clusters of variables. This is evident by the fact that there is a large number of reasons which are addressing the same issue however, with different interpretations.

Having said that one can now match visually the conceptual framework of this thesis with all the reasons for adoption or rejection as being identified in the previous analysis (irrespective of agreement among firms). To this end the following figure 7.1. illustrates again the conceptual framework of this thesis. Each large box represents a homogeneous cluster of variables i.e. innovation characteristics. Each cell within a box represents an individual firm of those that participated in this study and each row identifies whether this firm is an adoptor or non-adoptor (a double line distinguishes them) of either innovation No.1, No.2, or No.3. When a firm has cited a reason which can be placed within a cluster of variables its cell is darkened.

However, it must be stated here the difficulty faced by the author of this thesis when attempting to classify individual reasons for adoption or rejection, within homogeneous clusters. Indeed, reasons for adoption such as increasing production needs can be regarded as being mediated both by industry specific conditions i.e. increase in quantity demanded by customers, and by production related conditions, i.e. a production capacity that has reached its limits. To overcome this problem, the clustering of reasons was based upon past theoretical insights as they have been developed throughout the literature review part of this thesis.

Figure 7.1. : Visual matching of the conceptual framework with the reasons for adoption or rejection.



Armed with the above insights, figure 7.1. indicates that clusters of factors, provided by the conceptual framework of this thesis, are sufficient denominators of the reasons for adoption or rejection provided by firms in this study. Moreover, the relative emptiness from darkened cells of the cluster indicating organizational and managerial factors is somewhat expected since innovations under consideration are mainly applicable to the production and the products of firms in this study. This is not to say that they had no influence in the adoption or rejection decision. Instead, they must be regarded as factors facilitating or impeding adoption in ways other than such as needs, opportunities, threats or objectives to be accomplished by the adoption of innovation. Overall, this figure (7.1) illustrates the robustness of the conceptual framework of this thesis.

To conclude, the present section has identified the reasons for adoption or rejection of the innovations as perceived by their adoptors and non-adoptors. However, the author deems that if the identification of perceptions is an important issue, the investigation of the factors that may have triggered these perceptions is of even greater importance.

The following sections therefore will take one step further. They will enquire into each cluster of variables in the conceptual framework of this thesis and they will attempt a more detailed investigation of the factors influencing adoption response. More specifically, the next section (7.2) will investigate the developmental and marketing activities of the innovations' suppliers with the aim to identify and establish a link among these activities and the reasons for adoption or rejection for each innovation.

Section 7.2.: ACTIVITIES UNDERTAKEN BY THE SUPPLIERS FOR THE DEVELOPMENT & MARKETING OF THE INNOVATIONS

7.2.1. INTRODUCTION

In chapter 2, it was documented that the development process of an innovation and the marketing activities, undertaken by the innovating firm, can have profound effects upon the innovations' adoption and diffusion performance in the market place. Moreover, in the same chapter, it was noticed the lack of research throughout the whole innovation process (development, adoption & diffusion) which eventually precluded the assessment of the effects of suppliers' actions upon the adoption performance of innovations. To this end, it was suggested that insights, to be gained from more exploratory research within the activities of the suppliers combined with simultaneous research within the activities of adoptors and non-adoptors of innovations, could provide useful insights and new directions for further research on this issue.

Armed with the reasons for adoption or rejection, stated by adoptors and non-adoptors in the previous section 7.1, and the past empirical findings and suggestions reviewed in chapter 2, the main objective of the present section is to describe and establish a link among specific developmental & marketing activities of the innovations' suppliers and reasons for adoption or rejection of these innovations as they have been stated by potential adoptors.

Bearing in mind the above objective, it was decided to undertake personal in-depth interviews within the firms of suppliers enquiring meticulously their activities during the development and marketing process of their innovations. The relevant raw data of these interviews are presented in a case study form in Appendix - A and are reported in an aggregate form in the discussion attempted in the present section. In this discussion the suppliers are indicated by the signs P1,P2 and P3 where:

P1:the supplier of the innovation No.1 (CNC BENDING MACHINE),
P2:the supplier of the innovation No.2 (PACKAGING MACHINE),
P3:the supplier of the innovation No.3 (POWER SUPPLY SYSTEM).

7.2.2. THE DEVELOPMENT OF THE INNOVATIONS

7.2.2.1. INCENTIVES FOR THE DEVELOPMENT OF THE INNOVATIONS

In chapter 2 it was presented the work of many researchers who documented well with empirical findings that, among other things, the incentives for the development of an innovation play a decisive role in their successful commercial performance. In that respect, Mayers and Marquis (1969), Globe et al.(1973), Rothwell et al. (1974), Maidique and Zirger (1984), found, among others, that commercially successful innovations were initiated by market needs.

In order to see whether such conditions have initiated the three innovations in question, respondents in each firm were asked to express in their own words the incentives on which one can attribute the development of each innovation. Their answers are illustrated in the following table 7.2.1.

As it can be seen from table 7.2.1, a diversity of incentives have been cited which incorporate issues related both to 'demand pull' (incentives no.1,2,9) and 'technology push' (incentive no.4) theories. However, it is interesting to note that for all firms, incentives related to their strategic orientations were cited (incentives no.3,5,6,7,8).

Furthermore, in one company (P1), the idea for the development of the innovation was introduced to it by a firm in the mattress industry in Greece, while in the remaining two cases (P2,P3) the incentives for the development of the innovations were realised through the commercial activities of the trading companies from which the two firms in question evolved.

Table 7.2.1: Incentives for innovations' development

INCENTIVES FOR INNOVATION DEVELOPMENT	Freq.	Firms
1. Realization of problems faced by customers using competitive products	2	P2 P3
2. Customer's idea	1	P1
3. The innovation could solve the problem for cash to support other activities of the firm	1	P1
4. It was an opportunity to apply the already known technology in other areas	1	P1
5. It was perceived as the only way to achieve export strategic objectives	1	P2
6. Opportunity since competition had not yet made full use of this technology	1	P2
7. To acquire experience in order to apply the same technology in other products of the firm	1	P1
8. Realization of competitive advantages (price, design skills)	1	P3
9. Fastly growing domestic and international market	1	P3

7.2.2.2. FACTORS LED TO THE FINAL DECISION TO DEVELOP THE INNOVATION & DEVELOPMENT ENABLING CONDITIONS

Most 'activity stage models' (Saren 1984) of the new product development process indicate that ideas generated in the first stage are followed by screening and evaluation activities that determine which idea will be attempted or not. To this end, Cooper & Kleinschmidt (1987) found, among others, that these activities and the criteria used for screening and evaluation determine to a great extent the commercial performance of the new product.

In the present cases, no screening was performed since firms were dealing with single ideas. However, the final decision to develop each innovation was taken through discussions held within each firm. To this end, thirteen factors were presented to respondents in order to find which and to what extent each of them has influenced the final decision to develop the innovation. A scale from 1 to 7 was used to assess the extent of influence for each factor, where 1: not at all and 7:to a great extent.

Table 7.2.2 illustrates the degree of influence of each factor per firm. Despite any minor differences among firms the most influential factors were the compatibility of the innovation with the technical knowledge and production capabilities of the firms. Of almost equally high influence was also the fact that the innovation was a technical challenge to the owner of the firm (which indicates the top management's support to the project) and that innovations were regarded as of low failure risk. In addition for two firms (P2,P3) the decision to develop the innovation was influenced to a great extent by the fact that there was a good market response and the innovation was in line with their objectives for facing their competitors' activities and following the general trends in the industry. The former is a clear indication of the innovations' compatibility with market needs and the strategic objectives of the firms.

Furthermore of great interest is the fact that the decision was influenced to a very small extent by the profit per unit to be gained by the innovation (firms P2 & P3) as well as by the fact whether the innovation could be patented or not. Regarding the latter, one firm (P2) stated that it did not think of patenting it because they knew that soon or later competitors will copy it. Another firm (P3) mentioned that patents are very expensive to be acquired and secondly the innovative characteristics of the innovation were related to design issues which were difficult to be copied by the competition. From a financial point of view it can be seen from table 7.2.2. that the payback period of the innovation played an important role in the firms' decision to develop the innovations. Although this is somewhat expected (due to the financial problems of small firms), when combined with the lower importance of the rest financial tools in table 7.2.2 (mainly for firms (P2&P3) it indicates the willingness of the producers to pursue and benefit from a wide diffusion of their innovations.

Table 7.2.2 : Factors led to the final decision to develop the innovation.

	Factors	P1	P2	P3	MEAN
1	R.O.I.	1	7	4	4
2	Payback period	4	6	5	5
3	Profit per unit	6	1	4	3.6
4	Compatibility with our production capabilities	7	7	7	7
5	Compatibility with our technical knowledge	7	7	7	7
6	Competitive activities	1	7	7	5
7	Good market response	2	7	7	5.3
8	Large number of potential adopters	2	7	7	5.3
9	Low failure risk	7	4	6	5.6
10	Vital for firm's image	1	7	5	4.3
11	It was a technical challenge to the GM	5	7	7	6.3
12	General trends in industry	1	7	7	5
13	Ease of patentability	3	1	2	2

Scale 1 to 7 were 1:not at all, 7:to a great extent

On aggregate, one can see from table 7.2.2 that three clusters of factors have influenced to a great extent the firms' decisions to develop the innovations: a) technological & technical factors related to firms' internal technical strengths, b) market factors related to number of potential adoptors and their response, and c) emotional factors related to the fact that the attempt to develop the innovation was a challenge to the owner of each firm.

In order to see which of the above or other factors have actually contributed to the successful development of the innovations respondents in each firm were asked to express in their own words the factors that enabled their firms to develop successfully the innovations. Their answers are illustrated in the following table 7.2.3. As it can be seen from this table, in all 3 firms the technical skills of the owners or employers, the small size of the firms and the existence of a product champion were cited as conditions vital for the development of the innovations.

Table 7.2.3 : Development enabling conditions

ENABLING CONDITIONS	Freq.	Firms
1. Technical skill (owners or employees)	3	P1 P2 P3
2. Small size and hence, commitment to the project	3	P1 P2 P3
3. Product champion owner of the firm	3	P1 P2 P3
4. Knowledge of the market needs through previous commercial activities	2	P2 P3
5. Effective use of external technical help	2	P1 P2
6. Application of technology used already in other products of the firm	1	P1
7. Customer who financed the project	1	P1
8. Customer who provided information for the development of the product	1	P1
9. Organizational structure that provided autonomy and commitment to projects	1	P3

Regarding the technical skills, they were attributed to the education, creativity or technical experience of the persons involved in the development (P1,P2,P3). Of great interest is the fact that in one case (P2) the technical experience was proliferated to the firm by incorporating in its staff the experienced employees of another firm which the firm in question had acquired. In addition, in the same case (P2), it was cited that the previous commercial activities of this firm (representatives of foreign producers) necessitated the servicing of different machinery which in turn enabled the firm to acquire invaluable technical knowledge and experience. Besides, the previous commercial activities of firms (P2 & P3) enabled them to concentrate upon specific technical issues when developing their innovations. These issues correspond to the technical problems their customers faced with the machinery of their competitors.

In concern to the small size of the firms, respondents explained that because of this, there was a high commitment to the project and for the period of development all available technical, financial and managerial resources were absorbed in this project. This was also substantiated in all cases by the owner of the firm who by acting as a product champion was making available the necessary technical skills and money resources to the project. All the above have contributed to quick decision making during the developmental process and the quick finding of solutions whenever technical problems appeared.

However in two cases (P1,P2) firms used external technical help by collaborating with firms specialized on electronics. In addition respondents from firm (P1), where the innovation was initiated by a customer, pointed out the technical help provided by him through information regarding his operations and the general specifications the innovation ought to have.

7.2.2.3. STAGES OF DEVELOPMENT & EVENTS

In his attempt to classify and review a large number of intra-firm innovation processes, Saren (1984) concluded that the different types of models used in the literature represent the investigators' attention on specific 'features of innovation' rather than on the process itself. To this end, as it was reported in Chapter 2, Cooper developed a typology of new product processes based on the mean duration time of a number of activities during the new product development process of a large number of products. He concluded that the most successful typology was the one which included most of the activities prescribed in the new product development and had a balance between technical and marketing activities throughout the process.

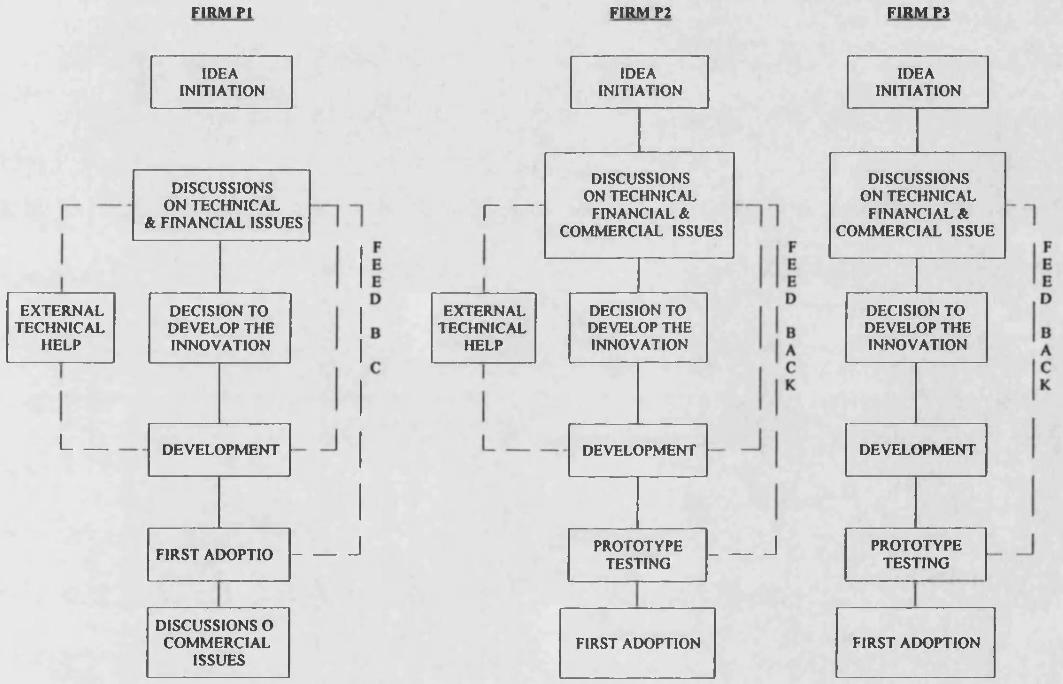
In order to see whether similar conditions were inherent in the present sample of producers, respondents in each firm were asked to describe in their own words their innovations' development processes which is as follows.

7.2.2.3.1. STAGES OF DEVELOPMENT/ PARTICIPATING PERSONS & SOURCES OF INFORMATION USED

The development process started in all firms with the idea initiation and continued with the stages which are illustrated in the following figure 7.2.4.

In one case (P1), the idea was introduced by a customer while in the remaining two cases (P2,P3), the idea was initiated within the firm by the managing director (not technician) and the technical director (technician) respectively. The introduction of the idea was followed by discussions of the technical, financial and commercial issues of the innovation. In one case (P1), only technical and financial issues were discussed due to the unfamiliarity with the market and the existence of the customer who was the first adopter of the innovation. The outcome of these discussions was the decision to develop the innovation and the next stage was its actual development. However, during that stage, two firms (P1,P2) faced many problems regarding the electronic parts of their innovations which in turn initiated more discussions within the firm and the use of external technical help by firms specialized in electronics.

Figure 7.2.4 : Stages of development



After the development of the innovation, in two cases (P2,P3), a prototype of the innovation was extensively tested within the firm. According to respondents from these firms, the prototype testing revealed minor technical problems of their innovations which were evaluated through discussions within the firm and appropriate actions were taken for their remedy. However, in one case (P1), although a prototype was developed it was not actually tested within the firm but it was given to the customer who initiated the idea according to the custom-made agreement the firm had with him. The marketing director of this firm explained that the lack of resources for an extensive in-firm testing forced the firm to 'use' the customer for the testing of the innovation. This innovation presented a lot of technical problems when operating in the customer's premises and the firm had to take it back for further development.

From a time duration point of view, respondents in all firms stated that their development process is much faster than that of their competitors abroad. Regarding time allocated in different stages within the process, firm (P1) spent less time at the initial stages and at the prototype testing than firms (P2 & P3).

Regarding persons that have participated in the development process, it was stated by respondents in all firms, that the whole process was performed by only a small number of persons. In all cases, these persons were the owners of the firms and technical staff of the firm. Despite the decisive role of the owners in each stage of development, it was stated by all firms that the decisions per stage were taken collectively. Of great interest is the fact that the persons participating in each stage were representing different areas of interest in the firm such as production, engineering, marketing and sales. Therefore, participants were capable of approaching each issue from different angles and to reach decisions quickly. In that respect the owner of one firm (P2) stated that 'it is difficult to separate technical from commercial discussions since a technical issue such as achievement of a packaging speed, involved also financial and commercial considerations and vice versa'.

Finally, table 7.2.5 illustrates the importance allocated by respondents on different information sources that have been utilized by them during the innovation development process.

Table 7.2.5 : Information sources used on specific stages.

Stages / Information Sources	Idea Initiation			Attributes Assessment			Technical Evaluation			Financial Evaluation			Commercial Evaluation		
FIRMS	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
Prior studies of mine		2	1			1			1		1	1		1	4
Prior experience		1		1	3	2	1	1	2	1		2	1		3
Formal contacts in firm			5	2	1	3	4	4	4	2	4	4	3	3	4
Personal formal contacts with members of other firms		3		3	2		2	2							
Contact with customers	1			4							3			4	2
Contacts with potential users													2	5	2
Market research			2			5					2	3		2	1
Technical journals			3	5	4	4	3	3	3						
Scientific journals			5												

As it can be seen from this table irrespective of the stage or task to be performed respondents perceive as more important their experience, their previous studies and the formal contacts within their firms all of which are sources internal to the firm. However, for specific tasks, external information sources are perceived as important too. In that respect, contacts with customers, potential user and market research, are important for the commercial evaluation while technical journals are consulted for the assessment of the innovation's characteristics and the technical evaluation of it.

7.2.2.3.2. ASSESSMENT OF TECHNICAL CHARACTERISTICS

Table 7.2.6 illustrates the factors that dictated the technical characteristics of the innovations alongside their extent of influence. As it can be seen respondents were influenced more by their firm's technical capabilities, machinery and equipment and by the financial evaluation of the innovation. These clearly represent technical and economic influences whereas market influences (users' perceptions and/or market research) were cited to a lesser degree. To this end, firm (P1), explained that the customer who initiated the idea did not provide substantial technical assistance. Rather he explained his operations and technical needs. Firm (P2) stated that, although they did a market research and assessed the users' perceptions, they were contradictory to each other and therefore, they were used only as general guidelines. Finally, in the case of firm (P3) it was stated by the technical director that the customers did not contribute a lot to the assessment of the final characteristics of the innovations mainly because of their lack of knowledge of the technology.

Table 7.2.6 : Factors influencing the assessment of technical characteristics

	FIRMS			
	P1	P2	P3	MEAN
Users' perceptions	4	2	3	3
Firm's technical capabilities	6	5	7	6
Firm's machinery & equipment	5	5	7	5.66
Market research	1	5	4	3.33
Financial evaluation	4	7	5	5.3

Scale 1 to 7 were 1:not at all, 7:to a great extent

7.2.2.3.3. FINANCIAL & COMMERCIAL EVALUATION-R&D RESOURCES SPENT AND USE OF EXTERNAL HELP

In the first case (P1), the financial evaluation was performed intuitively by the owner of the firm and it was an estimation and a comparison between the developmental costs and the final price they could charge to the customer rather than a formal evaluation based on financial tools. In the remaining two cases (P2,P3), the return on investment and pay-back period were used for the financial evaluation.

Regarding the commercial evaluation, firm (P1) did not attempt any because the innovation was developed under a custom-made agreement and, the market was totally unfamiliar to the firm. In firm (P2), the commercial prospects of the innovation were assessed through discussions with already customers where their interest was recorded. Based on that, on the competitive advantages of the innovation (technology, price), and on the past sales volume of the firm regarding other machinery, the managing director was able to anticipate the future sales volume for the innovation. In the case of the third firm (P3), the commercial evaluation was based on the past commercial experience of the sales director and the consulting of different published data regarding domestic and international demand for similar products.

For the development of the innovations all three firms spent 100% of their R&D budget of the period. In order to finance the development two firms (P1,P3) used external help which they regarded as very helpful. Specifically firm (P1) received the payments in advance of the customer who initiated the idea and a grant from the Hellenic Organization of Medium and Small Firms and Handicraft (EOMMEX). Firm (P3) received a grant from the same organisation and another one from the Greek Ministry of Research and Development. Firm (P2) financed the project by itself and the managing director explained this with the following reasons: a) since the firm was in Athens was not eligible of most of the development governmental incentives, b) governmental institutions were not trusted by the firm and were very bureaucratic in their decision making, and c) firm's policy is to finance its projects by its own resources since this provides a sense of urgency for quick results that assist the effective and efficient execution of the development process.

7.2.2.3.4. PROBLEMS DURING THE DEVELOPMENT

The following table 7.2.7 illustrates the problems faced by the firms during the development process of their innovations. The most important of them was the lack of necessary components domestically. Major reasons stated for that were: a) the special nature of the components and their narrow application which did not provide any incentives to trading firms to import them at all or in small quantities, b) the fact that the foreign producer has ceased to produce a specific component and his representative in Greece had failed to inform the firm which had already experimented with these components. To overcome these problems which caused many delays in the development, firms either made their own tooling (P2), or suffered additional costs by ordering larger quantities (P2,P3).

Table 7.2.7 : Problems during the development.

Problems during development	Frequency	Firms
Lack of necessary components domestically	2	P2 P3
Technical problems	2	P1 P2
Financial problems	1	P2
Lack of space	1	P3

Other problems faced by the firms were of technical nature and for the two cases (P1,P2) in which they were cited, they were related to the application of the electronic components of the innovation. This caused additional delays in the development and necessitated the collaboration with other firms in Greece which were specialized in electronics.

Finally, financial problems were suffered by a firm (P2) because the prototype testing period was very long and as the managing director said, during that time they were unable to have any money inputs because the innovation was not for sale yet. In addition, one firm (P3) mentioned problems of space within its factory which impeded the use of advanced quality control machinery and therefore, technicians had to spend a lot of time on quality control issues alongside design and development issues.

Up to this point the research and development activities of the suppliers of the innovations were investigated. The next section will attempt to investigate the marketing activities of the suppliers with regard to the innovations in question.

7.2.3. THE MARKETING OF THE INNOVATIONS

7.2.3.1. THE MARKETING EFFORTS AND THEIR FORMALITY

The three innovating firms in this study have followed different marketing approaches for their innovations.

To this end, the marketing director of firm (P1) explained that the efforts to market their product started only after its first adoption by the customer who initiated the idea for its development. The initiative to market the product widely was given to the firm by the large number of inquires they received from Greek firms in the mattress industry. The marketing director stated that by contacting these firms (which in the past had visited international exhibitions for machinery in the mattress industry), they were able to realise better the world-wide uniqueness of the product, and to consider seriously the exhibition of it in an international trade show. To this end they participated in an international exhibition where the interest of its visitors for the product was enormous. Moreover, in the same exhibition they were approached by the largest European manufacturer of machinery (a Swiss firm) in the mattress industry and they were offered to license their product to them. Despite attempts by competitors of the Swiss firm to stop such an agreement, they finally licensed the product to this firm for a large sum of money. A term imposed on the agreement was that the Swiss firm will sell during the following two years at least 36 items of the product which will be produced by the Greek firm. By the end of the two year period the international market for the product was going to belong to the Swiss firms while the Greek market was decided to remain to the Greek firm. According to the marketing director, the attempts to market the product in the Greek market continued formally by finding the addresses of potential buyers and by sending to them a direct mail explaining the existence and the technical specifications of the product in question. Moreover they continued participating in domestic and international exhibitions where Greek potential buyers were invited.

Regarding firm (P2), its managing director stated that the efforts to market their product started only after the end of the prototype testing period. Three reasons were presented by him for the non-existence of marketing efforts during the development process, i.e. to avoid pressures from customers wanting to use the machine before its extensive testing in the firm, to avoid delays in customers decisions who wanted to buy other products of the firm which were going to be replaced by the product in question, and finally to avoid an early copying of the product by competitors. The marketing efforts started with invitations which were sent to the major customers of the firm in order to see the packaging machine within the premises of the innovating firm. The next step was the participation in domestic and international exhibitions where the visitors addresses were recorded and within the following days they were sent a direct mail with a brochure of the machine, its technical specifications and information regarding the services provided by the firm as well as information regarding the economic conditions for its purchasing. According to the managing director the above procedure for marketing the products of the firm is the one used continuously by the firm although no written guidelines exist.

Finally regarding firm (P3), its sales director explained that marketing promotional activities were undertaken by the firm during the development process of the innovation. These were in the form of conference participations where the firm's technical director explained both the new technology as well as the trends in the industry and the formation of their company. By the end of the testing period of the product the parallel made brochures and leaflets, consisting of the technical characteristics of the products as well as of information about the company and its objectives, were mailed directly to potential buyers. The next step was to advertise the product in different Greek and international technical and trade journals and to get the first international safety approvals. According to the sales director this is a formal marketing procedure and whenever they receive an inquiry they invite the potential buyer in the firm where they answer in person any questions and in addition they offer a product free to him in order to be tested in his own premises.

7.2.3.2. INFORMATION MEDIA USED AND PROBLEMS

Thirteen different information media were presented to respondents in order to find which and to what extent each of them had been used by the firm in order to communicate the innovation among the potential adoptors. A scale from 1 to 7 was used to assess the extent of use for each medium, where 1: not at all and 7:to a great extent.

Table 7.2.8 illustrates the extent of use of each medium for each firm. This table indicates that firm (P3) has used a larger diversity of information media than firms (P1 and P2). In addition, firm (P3) has used to a greater extent than firms (P1 & P2) advertisements in technical and trade journals and contacts with universities. Finally, firm (P2) has used, in contrast with the others, to a greater extent formal and informal communications with colleagues by participating in conferences or in professional associations.

Regarding the most effective media, firms (P1,P2) mentioned the participation in trade shows, while respondents in firm (P3) mentioned that advertisements in technical journal proved to be the most effective medium and to their surprise they had taken enquiries from both foreign and domestic firms through the readers' inquiry service of the journals. In the same firm (P3) it was explained that they were not participating in domestic and international trade shows yet, due to the small range of their products.

On aggregate, the most extensively used media were direct mail with brochures and leaflets, participation in trade shows and informal contacts with colleagues. Of great interest is the fact that neither firm have door-to-door industrial salesmen.

Regarding the problems faced during the use of information media, respondents indicated the following: a) it is very expensive to participate in international trade shows (P1,P2,P3), b) it is difficult to find the addresses of foreign potential customers (P1), and c) the lack of technical journals in Greece where advertisements can be placed (P3).

Table 7.2.8 : Information media used for the innovations' marketing.

	FIRMS			
INFORMATION MEDIA USED	P1	P2	P3	MEAN
Brochures and Leaflets	2	7	7	5.3
Trade shows	6	7	4	5.6
Trade journals	2	1	4	3.0
Technical journals	1	1	6	2.6
Scientific journals	1	1	1	1.0
Personal contacts in professional associations	1	7	1	3.0
Participation in conferences	1	7	2	3.3
Contacts with Universities	1	1	4	2.0
Contacts with governmental institutions	2	1	5	3.0
Informal contacts with customers	1	7	5	4.3
Formal contacts of other firms' managers	1	7	2	3.3
Sales force contacts of potential customers	5	1	1	2.3
Direct mail	7	7	6	6.6

Scale 1 to 7 were 1:not at all, 7:to a great extent

7.2.3.3. INFORMATION MESSAGES USED

Table 7.2.9 illustrates the extent on which a number of different issues were included into the information messages communicated by the producers to their potential customers. As it can be seen from this table technical characteristics of the innovations the industry trends, and the financial opportunities and advantages to be gained by their use were included almost to a great extent in the information messages of the producer.

In addition to the above information, firms (P2 & P3) were including in their messages to a great extent information about the R&D resources allocated to the product and the after sales service they provide. Regarding the mentioning of the R&D resources, it was explained that this was used as a tool for justifying the price of the innovation (P2) and as proof that the product is not an imitation but a genuine one which has been developed through extensive research and development efforts (P3). Whereas it seems that these two firms had a strategic reason in communicating this kind of information, firm (P1) stated that they did not communicate similar information since no customer had any inquiry for the R&D resources absorbed. Regarding the after sales service the same firm (P1) stated that they were trying to avoid mentioning it since, when they introduced the innovation in the market they were unable to provide extensive after sales service and the same holds for its reputation which was very bad in Greece.

Table 7.2.9 : Information messages used

	FIRMS			
INFORMATION MESSAGES USED	P1	P2	P3	MEAN
Technical characteristics	6	7	7	6.6
Financial opportunities	6	7	4	5.6
Competitive advantages	1	7	2	3.3
Industry trends	4	7	7	6.0
Company's reputation	4	7	4	5.0
R&D allocation	1	7	7	5.0
After sales service	3	7	6	5.3

Scale 1 to 7 were 1:not at all, 7:to a great extent

7.2.3.4. SEGMENTATION

Firm (P3) had the clearest segmentation of its market and it seemed that it was the only firm that had devoted considerable thinking in order to do that. In that respect, it identified 5 segments namely: 1) firms using heavy machinery in which the innovation is replacing their old power supply system, 2) computer users who replace their computer's power supply system with the innovative one for reasons of safety, efficiency or because of other problems they have with the old one, 3) heavy machinery manufacturers where the innovation is a necessary component for their operation, 4) computer manufacturers and 5) state owned enterprises such as the Greek electricity and telecommunication companies. The firm was targeting segments no.3&4 while their strategic objectives were to enter segment no.5 after the increasing of their product range and the creation of a good reputation in Greece.

Firm (P1) had a general geographic segmentation (domestic and international market) and firm (P2) had in mind a segmentation upon firm size where the very large firms were avoided by the firm since they were the main target of foreign competitors which the firm in question could not easily match.

In financial terms, firms (P1&P2) when selling their innovations, were accepting the 30% of the total value when the agreement was made, 30% upon delivery and the remaining 40% within the following 6-8 months. In technical terms, firms (P1&P2) were offering the installation of the innovation and the training of the workers to use it.

In addition to the above, firms (P1&P2) were offering to their potential customers other services such as export services through their international connections (P1), information about technological improvements in packaging materials (P2), and help to get financial assistance for the adoption of the innovation through their connections and good reputation with banks in Greece. Similarly in firm (P3) help was offered to the potential customers relevant to design issues of the electronic parts of their products.

7.2.3.5. METHODS FOR REDUCING CUSTOMERS' RISK

Respondents in each firm were asked to indicate on a scale from 1 to 7, the extent to which the perceived risk of the customer was taken into account by the firm. Where 1:not at all and 7:to a great extent. Two firms (P1,P2) stated that they take it into account moderately (point 4) while firm (P3) indicated that they take it into account to a great extent (point 7).

To explain that difference, respondents in firms (P1,P2) stated that according to their opinion the perceived risk of the customer in the adoption of their innovations is moderate because the output capabilities of the innovation are clear (P1) and their firm is well known and has a good reputation in Greece (P2). According to their experience, the risk perceptions they have identified were related to the fact that innovations were produced in Greece and customers were not feeling very confident in buying Greek high technology products.

Regarding firm (P3), it was mentioned that the customers' perceived risk is high since the decision to incorporate in their products the innovation in question makes the performance of their products dependable upon the performance of the innovation and upon the performance of the innovating firm (i.e. continuous and on-time supply of the innovation).

Table 7.2.10 illustrates the extent to which various methods have been used by the firms in order to reduce any risk perceived by their customers in their decision to adopt the innovations.

Table 7.2.10 : Risk handling methods

	FIRMS			
RISK HANDLING METHODS	P1	P2	P3	MEAN
Visit operations	6	7	7	6.6
Visit other customers	4	7	7	6.0
Accept penalty contracts	1	4	7	4.0
Provide technical information	3	7	7	5.6
After sales service	4	7	7	6.0
Trial	2	7	7	5.3

Scale 1 to 7 were 1:not at all, 7:to a great extent

Firm (P1) mentioned that the most effective method was the invitation of the customer to visit the firm's operations while firms (P2,P3) indicated the invitation to visit other customers as the most effective method. In addition, firms (P1,P2), explained that they try to 'hide' the fact that their innovations have been developed in Greece by creating a perception that the innovation has been developed in Western countries of advanced technology and it is only assembled in Greece because of its lower labour cost. To this end, firm (P1) never uses the sign 'Made in Greece' and firm (P2) uses the label 'Made in EEC'. Finally firm (P3) tries to reduce customers' perceived risk by building good relationships with them and by pointing out the fact that both the innovation and its components have international standards of approval.

7.2.3.6. AFTER SALES FEED-BACK & ADJUSTMENTS

As it was stated by respondents in all firms the after sales feed-back is a formal procedure which is performed continuously through phone-calls and visits to customers. All firms indicated that after sales information have provided many useful insights regarding the further technological development of their innovations and the use of more effective selling strategies.

7.2.3.7. VISITS PER SALE/ PERCENTAGE OF SALES SPENT FOR THAT INNOVATION/ PERCENTAGE OF ADOPTERS THAT WERE ALREADY CUSTOMERS OF THE FIRM

Since no firm has door-to-door industrial salesmen the contacts between firms and customers were made mainly via phone-calls, fax and direct mail. However, after the selling agreement technicians from the innovating firms visit extensively their customers in order to install the innovation (P1), to assess the customers' operating conditions and needs, so as to modify the innovation accordingly (P2,P3).

Respondents in each firm were asked to indicate the marketing expenses spent for their innovations as a percentage of their sales turnover. To this end 10%, 30% and 30% were indicated from firms P1,P2 & P3 respectively

Regarding the adoptors of each innovation, firms (P1,P3) stated that none of them was an already customer of the firm while for firm (P2), 30% of the adoptors were already its customers.

7.2.3.8. MAJOR REASONS FOR ADOPTION OR REJECTION AS PERCEIVED BY THE PRODUCER

The following table 7.2.11 illustrates the reasons for adoption or rejection of the innovations as perceived by their producers.

Table 7.2.11 : Reasons for adoption or rejection

	PRODUCERS		
PERCEIVED REASONS FOR ADOPTION	P1	P2	P3
Technical reasons	X	X	X
Modifications to fit customer's needs		X	X
Labour savings	X	X	
Flexibility in use	X		
Accuracy	X		
Price		X	
Good reputation of producer		X	
Good after sales service		X	
Greek added value of the product			X
Close relationship and frequent communication with customers			X

	PRODUCERS		
PERCEIVED REASONS FOR REJECTION	P1	P2	P3
Doubts regarding high technology products produced in Greece	X	X	X
Small production output of Greek firms (potential adopters)	X	X	
Lack of experience & knowledge of technological developments		X	X
Bad reputation of the producer	X		
Competition from neighbour countries		X	
Price compared to lower quality products			X

7.2.4. CONCLUDING REMARKS REGARDING THE INNOVATIONS' DEVELOPMENT AND MARKETING ACTIVITIES

The preceding discussion has highlighted the development and marketing activities within each firm that have produced each of the three innovations in question. This section started with the aim to describe and establish a link among specific developmental & marketing activities of the innovations' suppliers and reasons for adoption or rejection of these innovations as they have been stated by potential adoptors.

Has the present discussion achieved this objective? The rest of this section will focus on answering this question.

A. ***Commercial activities of suppliers bring ideas for new products close to the actual market needs.*** As it was shown in the previous section (7.1) all adoptors mentioned the technical characteristics of the innovations among the reasons for adopting them. Moreover, these characteristics were compatible with their specific needs. Theory suggests that innovations which are initiated by customers stand a better chance for serving real markets needs and thus to be well accepted by the market than innovations initiated by the manufacturer.

In this study, although all three innovations were serving real market needs, only one of them (case of P1) was initiated by a customer whilst the remaining two were initiated by their producers (MAP instead of CAP) through their market experience from the commercial companies they had. Although this finding may be of little theoretic value (i.e. a particular feature of the present sample), it might be of great empirical value to managers or policy makers who either want to pursue the development of innovations or to create the necessary conditions for the identification of the most promising ones. Also, it may be of particular significance for small-sized firms which lack the necessary resources and knowledge for using more sophisticated methods for generating ideas for new products (see Chapter 8: Practical Implications).

Whilst the identification or real market needs can be attributed to the previous commercial activities of the companies and the collaboration with customers, the successful technical translation of these needs into a product can be attributed to the conditions which have enabled the development of the innovations. To this end, tables 7.2.2 and 7.2.3 indicate that the factors used by the firms to decide upon the development of the innovations have indeed contributed to their successful development. In addition table 7.2.3 shows that 5 enabling conditions were critical to the development of the innovations in more than one innovating firm i.e. technical skills, small size, existence of product champion, good knowledge of market needs and effective use of external technical help. These results accord with the empirical findings of many researchers who have claimed, among other, that compatibility of the innovation with the firm's internal technical strengths, compatibility of the innovation with market needs and top management support are among the most important factors in deciding the commercial success of the innovation (BAH 1982, Souder and Chakrabarti 1979, Link 1987, Rothwell et al.1974). Furthermore they support the arguments raised by Utterback (1975) and Freeman (1982) in favor of small innovating firms due to their ability to concentrate and commit their resources in a few major projects as opposite to large firms which devote less resources to more projects. Finally, the effective use of external technical help by two of the innovating firms (P1,P2) accords with the findings of Parkinson (1984) who found, among others, that firms with outstanding records of commercially successful new products were heavily involved with third parties during the development process of their products.

Nevertheless, it is interesting to note here that producing firms have faced many problems during the development of their innovations. One problem was related to the domestic lack of components necessary for the development of the innovations. Clearly, this is an indication of the poor infrastructure of the country in question. However, together with previous findings it highlights the fact that the successful generation and development of new products is closely associated, among other things, with the links that a producing firms has established with a). its customers, b). its suppliers and c). other firms which can contribute technological insight in the process of development. Further, it highlights the fact that no firm, especially small-sized ones, is a technological island. Collaboration may bring strengths, otherwise unapproachable, to firms producing innovations.

B. ***Events during the development process of an innovation have crucial effects upon the performance of the innovation in the market place.*** In the present study firms (P2 & P3) have followed the majority of steps prescribed by 'stage activity models' (Saren 1984), a condition critical to the success of innovations (Cooper 1983b). Moreover, as it was noticed from the case studies, only a small number of persons were involved in the development process, among which a dominant figure was the owner(s) of each firm. This fact highlights the lack of complexity in decision making in small firms which has been identified by many authors (Freeman 1982) as a decisive factor for the success of innovations. Indeed the present cases indicate that participation of few persons across the whole range of stages in the development process increases their ability to perceive better the interactions of their decisions on each stage of development. Furthermore, since decisions on technical issues have financial consequences and vice versa, the participation of the owner(s) in the development process provides the necessary authority for the allocation of the relevant resources.

However, in the case of the innovating firm (P1), figure 7.2.4 indicates that in comparison with firms (P2,P3) a somewhat different development process was followed. More specifically, commercial issues were not tackled at the early beginning of the development process and a prototype testing was not performed before the first adoption of the innovation by the customer who had also introduced the idea for the development of the innovation. As it was found in the previous section 7.1, the latter event caused dissatisfaction to this customer who eventually became a source of negative information to other potential adoptors regarding the performance of the innovation and the credibility of its supplier. This in turn was found among the major reasons for the rejection of the innovation by potential customers and it is a clear evidence of the negative effects of an activity during the development process upon the later adoption of the innovation.

Here, it is challenging to attempt explaining why this firm neglected the commercial evaluation of the innovation and the stage of prototype testing. According to the Marketing Director of that firm (P1) these events were attributed to the lack of resources for an extensive prototype testing and a lack of interest in the Greek market as opposite to foreign ones. However reference to tables 7.2.1 & 7.2.2, indicates that contrary to firms (P2 & P3) which had a clear strategic orientation in their development efforts, firm (P1) had a short term orientation regarding its innovation. Indeed, although the innovation was perceived as an opportunity to apply the already known by them technology in other areas (incentive No.4 in table 7.2.1), it was regarded, at that time, as a cash generator for supporting other activities of the firm (incentive No.3 in table 7.2.1). The latter can also be supported by reference to table 7.2.2, where the profit per unit was taken into account to a great extent in their decision to develop the innovation. Furthermore, this short term orientation can be attributed to the fact that the firm did not attempt to assess the commercial prospects of this product since, according to its General manager the customer was existed.

In a follow-up interview, the above explanation was confirmed by the Marketing director of firm (P1) who added that at the time of the development of this innovation the firm's orientation was towards generating cash for attempting the next innovative idea of its General manager and not towards capitalising upon the innovations already developed by the firm. This highlights the adverse effects upon the innovations' performance in the market place from the lack of a critical balance between the firm's strength in producing innovations and its marketing capabilities.

However, as it was shown previously this imbalance was compensated by the fact that the innovation was licensed to a leading European firm manufacturing machinery and equipment for the mattress industry. As it was stated by the marketing director of the producing firm (P1), this practice proliferated a large sum of money to the firm thus enabling the development of other innovative products and contributing to the development of the company. This is a clear indication that small innovative firms may benefit from the use of alternative methods for exploiting their innovations.

Nevertheless, the marketing director stated that plans were made in his firm in order to engage in own marketing of the innovations produced by the firm. To this end, it was considered the formation of a commercial/ marketing division (or firm) responsible for the marketing of the innovations produced. Although totally independent, this division was expected to communicate closely with the research and development department of the firm. It is interesting to note here that such an approach was already in use by the innovating firm (P2), although the level of its marketing knowledge was still inferior to its capabilities for producing innovative products.

C. ***Learn and Innovate or Innovate and Educate your Customers?*** The investigation of the process for the development and marketing of the innovations in this study has revealed that it is a process of continuous learning for the producers. At its early stages they have learned about their customers' needs by means of their commercial activities and their collaboration with customers; this has assisted the generation of ideas for new products and their development. At the later stages of the process they have learned the specific operational procedures of their customers and the considerations underlying their willingness or hesitation to adopt the innovations; this in turn, has resulted to the further development and/or modification of the innovations and the educating or assisting of their customers. The latter activities were in the form of 'side' services to their customers such as, *technological* (i.e. how to solve technical problems when developing their products (case of P2 and P3), how to use new packaging material for their products (case of P2)), *commercial* (i.e. how to achieve exports (case of P1)) and *financial* (i.e. how to raise capital (all cases)) services, accrued mainly from their technological expertise and/or their industrial and commercial connections nationally or internationally.

Armed with these insights, one can confidently state that a *duality* of roles for suppliers is beginning to emerge. One role is that suppliers (producers) of innovations *by learning* from their customers they develop and modify their innovations in order to align their products according to the conditions and needs of the potential buyers. This activity makes the innovation more compatible with the needs and conditions of the buyers thus assisting the adoption and diffusion of the innovations in the market place. A second role of the suppliers (and of equal importance to the previous one) is that *by educating* their customers they improve their operating conditions so as to enable the adoption and the efficient use of the innovation by them.

The first of the above roles of suppliers has long been acknowledged in the marketing discipline and according to the author's opinion it derives from an extreme focus of research to the demand side of innovations (i.e. marketers should use their marketing mix variables in order to adjust their products according to the conditions and the needs of the buyers). However, the present study indicates that the educating role of suppliers is of equal importance in the adoption process since it can affect customers' response towards the adoption of innovations (see reasons for adoption or rejection in section 7.1). Clearly, more research is needed in this field in order to identify the educating opportunities of suppliers. The present study suggests that these opportunities may derive from the technological, commercial and financial capabilities of the suppliers. To the author's knowledge, research efforts in this area have only tackled the effects upon adoption of activities in the form of financial help (Robertson & Catignon 1989), which can possibly be attributed to influences from the research on promotional activities in the consumer marketing domain.

D. *Exploitation of an innovation entails marketing strengths.* Theory suggests that small manufacturing firms should concentrate their efforts on specific market niches and exploitate to their advantage the fact that these segments seem unprofitable for larger firms (Kinsey 1987). To this end the preceding discussion indicates that while the innovating firms in this sample were capable of identifying market niches in order to establish themselves and develop their innovations, they did not follow a similar approach when marketing their innovations. The latter can be attributed to the lack of expertise by the firms in the area of market segmentation, which eventually results to a non-focused marketing campaign.

Moreover, it became apparent from the above discussion that the most extensively used medium for communicating information to potential customers is the direct mail with brochures and leaflets without any door to door salespersons which indicates the use of low-cost marketing strategies (Weinrauch et al. 1991) by these firms. Nevertheless, it was found that their most frequently used marketing tool (i.e. direct mail) is highly impersonal and informative of only the existence of the innovating firm and the characteristics of its innovation, without any specific reference to the needs of individual customers. Therefore, the role of the innovating firms in raising the customers' interest can be regarded as passive; they would rather wait for a customer's inquiry and order than pull for them. According to personal interviews with the marketing and sales managers of the innovating firms, their role becomes active only after a specific customer has expressed his interest for the innovation. Nevertheless, the relatively passive role of the innovating firms in raising the customers' interest also may be attributed to the fact that communication media are difficult to be used, owing to a). lack of domestic technical journals where high technology products can be advertised and b). the high cost for participating in international trade shows and exhibitions or for advertising in international technical journals.

Overall, a lack of marketing expertise is characterising the innovating firms in the present study. This is even more evident in their attempts to enhance their image in the market place. Instead of outlining their technological achievements and their focus to customers thus projecting a picture of trustworthy firms they resort to methods such as hiding the fact that their innovations have been developed in Greece (case of P1 & P2), thus creating wrong impressions to potential customers. Although this is an activity dedicated to overcome the earlier postulated fears of potential customers towards a Greek originated innovation (Section 7.1.) it might have hazardous long term implications both for the image of the innovating firms in particular and in general for the image of the Greek industry (See Chapter 8 : Practical implication). Unfortunately the present results indicate that the latter fears of potential customers are justifiable. Indeed, it seems that the endeavour of producers for technical excellence is not followed by the same effort for excellence in their corporate business. *However, the fears of the potential customers and the attention they pay in the supplying source of an innovation clearly indicate that the conduct of the innovation process cannot be seen in isolation from the conduct of the corporate business.*

To conclude, it can be said that this section has achieved its objective. A link was established between specific development and marketing activities of the suppliers and the reasons for adoption or rejection of the innovations. In addition the investigation of the development and marketing process of the innovations has revealed the main problems and opportunities that producers have faced when developing and marketing their innovations. Overall, the producers in the present study can be characterised as firms with technical strengths that enhance the market performance of their innovations which however, is undermined by an overlaying lack of marketing knowledge.

Despite the above lack of expertise in marketing, table 7.2.11 indicates that suppliers have clear perceptions of the reasons for the adoption or rejection of their innovation. Furthermore, it is interesting to note that these perceptions coincide to a large extent with those of the adoptors and non-adoptors stated in the previous section 7.1. Given this input and the willingness of firms to learn and advance their marketing efforts one can expect positive results in the future from any efforts of these firms towards elevating the reasons which enhance adoption and minimising those which impede adoption of their innovations.

Clearly, such an effort will become more effective if firms understand also the other clusters of factors which the conceptual framework of this study postulates that they affect the adoption response of firms towards innovations.

The next section therefore, will investigate the perceptions of adoptors and non-adoptors towards the characteristics of the innovations in question and will establish their role in the decision of the firms which are included in this study to adopt or reject an innovation.

Section 7.3.: THE INFLUENCE OF INNOVATIONS' CHARACTERISTICS AND PERCEIVED RISK UPON ADOPTION RESPONSE

7.3.1. INTRODUCTION

A survey of the available literature in chapter 3 indicated that the potential adoptors' perceived characteristics or attributes of innovations, as well as the risk perceived by them, play a critical role in their decision to adopt or reject an innovation. Moreover, in the same chapter an attempt was made to integrate findings on innovation attributes developed within the adoption & diffusion research tradition and the organizational buying behaviour research tradition. This attempt indicated that both tangible and intangible perceived attributes influence the adoption decision, highlighted the similarities and controversies among different research findings and finally, postulated the need for more research on the issue.

On the basis of the above, it was decided to investigate further the role of innovation attributes and perceived risk upon the decision of firms to accept or reject an innovation. More specifically, it was decided to explore the link between perceived innovations attributes, perceived risk and adoption behaviour, as well as the link between the level of perceived risk and the practices followed by potential adoptors when evaluating a supplier or when attempting to reduce any risk perceived in buying an innovation. In addition, it was explored the perceived adequacy of the information provided by the supplier and its link with the perceived risk of potential adoptors. As such, the results relating to these aspects will be presented in the following sequence:

a) Perceived innovations attributes and the adoption response.
b) Perceived risk and the adoption response.
c) The link between perceived risk and the perceived adequacy of the information provided by the supplier and between adoption response and practices used to evaluate the supplier and to reduce the levels of risk.

7.3.2. INNOVATIONS ATTRIBUTES AND ADOPTION RESPONSE

As it was mentioned in chapter 6, a list of the innovations' attributes was compiled by means of reviewing the available literature, consulting the suppliers of the innovations and the engineers in the EOMMEX. This list is consisting of 17 attributes which however, are not all applicable to all innovations, a fact that makes the comparability of results across innovations difficult. Therefore it was felt that an initial analysis on an innovation by innovation basis could produce better insights regarding the differences in the perceptions of adoptors and non-adoptors. To this end, respondents were asked to indicate, according to their perceptions, on a scale from 1 to 7, the extent to which the innovation adopted by them is possessing each attribute, where 1: not at all and 7: to a great extent.

The link between adoption response and perceived innovations' attributes is illustrated in the following table 7.3.1., where from the following conclusions emerge:

1. Data indicate a tendency according to which adoptors perceive the innovation adopted by them as possessing to a greater extent, each of the 17 characteristics examined (if applicable) than non-adoptors do. However, caution must be suggested here since a degree of bias may exist among adoptors due to their use of the innovations.

2. The attributes on which the perceptions of adoptors differ significantly than those of the non-adoptors seem to be different for each innovation. To this end, regarding the CNC BENDING MACHINE, data indicate that perceptions differ significantly for the attributes no. 2,8,10,11,14 in the above list. Similarly, significant differences in perceptions exist for the PACKAGING MACHINE and the POWER SUPPLY SYSTEM for the attributes 5,6,7,14,17 and 2,11,17 respectively. Such differences in the perception of adoptors and non-adoptors of different innovations clearly undermine the comparability of results from different innovations and substantiate the claims of many researchers that a universally accepted classification scheme of innovations based upon their attributes is inapplicable.

3. However, in spite of the above, data from table 7.3.1 indicate that adoptors and non-adoptors of all innovations show statistically significant differences in their perceptions of the extent to which the innovations encompass advanced technology. More specifically, adoptors perceive the innovations as incorporating advanced technology to a greater extent than the non-adoptors do. The latter supports the recent work of Dunn et al. (1991), who found that contemporary firms show a positive inclination towards products with advanced and high technology.

Table 7.3.1. : Characteristics of innovations as perceived by adoptors and non-adopters

	Characteristics of the CNC Bending Machine (Innovation No. 1)	Adopters	Non-Adopters			
		Mean Rank		Cases	U	Sig.
1	Low initial cost	6.42	4.13	6,4	6.5	0.117 (V)
2	Low maintenance cost	7.42	2.63	6,4	0.5	0.006 (*V)
3	Low pay-off period	6.08	4.63	6,4	8.5	0.222 (V)
4	High flexibility in use	6.17	4.50	6,4	8.0	0.167 (V)
5	High reliability in operation	5.67	5.25	6,4	11.0	0.411 (X)
6	Ease of understanding its use	5.92	4.88	6,4	9.5	0.283 (V)
7	Labour savings	6.17	4.50	6,4	8.0	0.187 (V)
8	Product quality improvements	6.75	3.63	6,4	4.5	0.046 (*V)
9	Space savings	5.67	5.25	6,4	11.0	0.414 (X)
10	It is compatible with existing manufacturing operations	6.75	3.63	6,4	4.5	0.046 (*V)
11	It is compatible with the existing technical experience and expertise	6.92	3.38	6,4	3.5	0.031 *V)
12	Lowers the unit cost of end product	6.08	4.63	6,4	8.5	0.221 (V)
13	Permits trial in small scale	----	----	----	----	----
14	Provides better equipment utilization	7.33	2.75	6,4	1.0	0.007 (*V)
15	Introduces savings in production time	6.17	4.50	6,4	8.0	0.166 (V)
16	Increases variety of end products	6.17	4.50	6,4	8.0	0.142 (V)
17	It encompasses advanced technology	6.92	3.38	6,4	3.5	0.028 (*V)

	Characteristics of the Packaging Machine (Innovation No. 2)	Adopters	Non-Adopters			
		Mean Rank		Cases	U	Sig.
1	Low initial cost	6.17	4.50	6,4	8.0	0.190 (V)
2	Low maintenance cost	6.17	4.50	6,4	8.0	0.190(V)
3	Low pay-off period	6.58	3.88	6,4	5.5	0.076(V)
4	High flexibility in use	6.33	4.25	6,4	7.0	0.134(V)
5	High reliability in operation	7.00	3.25	6,4	3.0	0.018(*V)
6	Ease of understanding its use	7.33	2.75	6,4	1.0	0.006(*V)
7	Labour savings	7.08	3.13	6,4	2.5	0.017(*V)
8	Product quality improvements	6.58	3.88	6,4	5.5	0.079(V)
9	Space savings	6.08	4.63	6,4	8.5	0.199(V)
10	It is compatible with existing manufacturing operations	6.33	4.25	6,4	7.0	0.131(V)
11	It is compatible with the existing technical experience and expertise	6.50	4.00	6,4	6.0	0.093(V)
12	Lowers the unit cost of end product	6.50	4.00	6,4	6.0	0.092(V)
13	Permits trial in small scale	----	----	----	----	----
14	Provides better equipment utilization	6.92	3.38	6,4	3.5	0.028(*V)
15	Introduces savings in production time	6.50	4.00	6,4	6.0	0.056(V)
16	Increases variety of end products	6.08	4.63	6,4	8.5	0.216(V)
17	It encompasses advanced technology	6.92	3.38	6,4	3.5	0.028(*V)

	Characteristics of the Power Supply System (Innovation No. 3)	Adopters	Non-Adopters			
		Mean Rank		Cases	U	Sig.
1	Low initial cost	5.60	4.25	5,4	7.0	0.220(V)
2	Low maintenance cost	6.70	2.88	5,4	1.5	0.013(*V)
3	Low pay-off period	5.30	4.63	5,4	8.5	0.330(V)
4	High flexibility in use	5.80	4.00	5,4	6.0	0.136(V)
5	High reliability in operation	5.60	4.25	5,4	7.0	0.185(V)
6	Ease of understanding its use	----	----	----	----	----
7	Labour savings	----	----	----	----	----
8	Product quality improvements	5.40	4.50	5,4	8.0	0.279(V)
9	Space savings	----	----	----	----	----
10	It is compatible with existing manufacturing operations	5.80	4.00	5,4	6.0	0.136(V)
11	It is compatible with the existing technical experience and expertise	7.00	2.50	5,4	0.0	0.005(*V)
12	Lowers the unit cost of end product	5.90	3.88	5,4	5.5	0.120(V)
13	Permits trial in small scale	5.90	3.88	5,4	5.5	0.129(V)
14	Provides better equipment utilization	----	----	----	----	----
15	Introduces savings in production time	----	----	----	----	----
16	Increases variety of end products	----	----	----	----	----
17	It encompasses advanced technology	6.40	3.25	5,4	3.0	0.028(*V)

In chapter 3 it was reviewed the work of many researchers who claimed, among other things, that innovations' attributes are part of a complex where they interact with each other. In order to take into account these interaction the use of partial correlation or factor analysis was suggested (Fliegel & Kivlin 1968, Tornazky & Klein 1982).

In the present case, the small size of the sample, the type of variables, and the situational applicability of some attributes make the above methods inappropriate. Instead, it was decided to construct an additive aggregate variable (Attributes total score) which, although it can not take into account the interactions among attributes, it is however, capable of producing a single score for each innovation comparable with that of the other. To this end, the ratings for each innovation's attribute were aggregated and divided by the number of attributes applicable to each innovation according to the following mathematical formula.

$$\text{Attributes Total Score} = \frac{\sum_{i=1}^{n}(T_i)}{N}$$

Where:
Ti = Perceived score of each attribute
i = Attribute no.1 to attribute no.17 in table 7.3.1.
N = Number of attributes applicable to each innovation

The value range of this variable is from 1 to 7, where 1 the innovation is equipped to a very low extent with the above attributes, and 7 the innovation is equipped to a great extent with the above attributes. This variable therefore, projects a single picture of each innovation and as its reliability coefficient indicates, is a good representation of the adoptors and non-adoptors perception of the innovations' individual attributes (Cronbach's a = 0.8559).

The link between the overall perception of each innovation and adoption response is illustrated in table 7.3.2. which confirms the hypothesis that adoptors' overall perception of each innovation is higher than that of the non-adoptors.

Table 7.3.2. : Attributes overall perception and adoption response
VARIABLE : Attributes Total Score

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	20.00	7.92	17,12	17	0.000 (*V)

COMMENT: The adoptors' overall perceived picture of the innovations' attributes is statistically significantly higher than that of the non-adoptors.

7.3.3. PERCEIVED RISK AND ADOPTION RESPONSE

In chapter 3, it was shown that one major dimension of the potential buyers' perceived risk is their uncertainty about the consequences of their buying decisions (Newall 1977, Hawes & Barnhouse 1987). This uncertainty undermines the confidence of potential adoptors, and contributes to their decision to reject or postpone the adoption of technological innovations, which by their very nature (newness), are full of uncertainties. Furthermore in the same chapter it was shown that such uncertainties were connected, among other things, with the credibility of the supplier regarding the technical specifications of the product, the technical characteristics of the product and the expected advantages over competitors to be gained by its adoption (Valla 1982, Peters and Venkatessen 1973). By implication, the higher is the confidence of a potential adoptor to all of the above issues, the lower will be his level of perceived risk. Taking this as a basis it was decided to investigate the link between the confidence of adoptors and non-adoptors on the above issues when taking their final decision to adopt or reject the innovation. To this end, the operationalization of the variable: Degree of confidence in the final decision, involved the following steps:-

a) Respondents were asked to indicate on a scale from 1 to 7 the degree of their confidence on the following issues: The innovation would meet the claims of the supplier on performance, it would be compatible with the existing manufacturing operations, it would be reliable, it would be easy to operate, it would be easy to maintain and it would provide the expected advantages over the competitors' products. Where 1: not confident at all and 7: very confident.

b) The individual scores were then factor analyzed by the use of a varimax principal components analysis. To this end one factor was produced of eigenvalue: 4.26529 capable of explaining 71.1% of the variance of the six variables included in the factor analysis. However, due to the small size of the sample, the factor analysis was taken into account cautiously. Thus, instead of factor scores simple aggregate results were used in order to construct a single aggregated variable to represent the respondents' confidence in their decision. As its reliability coefficient shows, this single variable proved to be a good representation of the variance of the six individual variables (Cronbach's a :0.9179)

The link between the perceived confidence of potential adoptors and their final adoption response is illustrated in the following table 7.3.3. which confirms the hypothesis that, a higher degree of confidence on aspects which mediate risk is connected with adoption rather than non-adoption.

Table 7.3.3. : Confidence in the final decision and adoption response

VARIABLE : Degree of confidence in the final decision.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	19.44	8.71	17,12	26.5	0.000 (*V)

COMMENT: When the final adoption or rejection decision was taken the adoptors were more confident for the supplier's credibility, the technical characteristics of the innovation and its expected advantages, than were the non-adoptors.

7.3.4. *THE LINK BETWEEN PERCEIVED RISK AND INFORMATION RECEIVED FROM THE SUPPLIER*

Results reported thus far in this section indicate that adoptors of innovations were more confident than the non-adoptors on a number of aspects related to their buying decision. In addition, the innovations were evaluated by them higher than by the non-adoptors on a number of perceived attributes. However, these results do not explain the underlying reasons for the existence of such differences between adoptors and non-adoptors. To this end useful insights have been already reported in section 7.3.1 where it was shown that attributes of innovations were perceived in one or another way, depending upon the external and internal environment faced by each firm, as well as upon their perceptions of the supplier, and his capabilities.

Regarding perceived risk, as it was reported in chapter 3, its levels are influenced, among other things, by the supplier himself, i.e. when his performance and characteristics are taken into account in the evaluation process of potential adoptors, by his actions, i.e. when communicating information, and by the risk reducing activities of the potential adoptors (Hakanson and Wootz 1975, Bettman 1973, Roselius 1971). To gain more insights into these issues, it was decided to test the existence of a link between perceived sufficiency of information provided by the supplier and perceived risk, and hence, between perceived sufficiency of information and adoption response. Moreover it was decided to investigate the differences among adoptors and non-adoptors regarding the criteria used for the evaluation of supplier and the practices used to reduce their perceived risk.

The link between adoption response and perceived sufficiency of information provided by the supplier on specific issues is illustrated in the following table 7.3.4. from which a number of conclusions emerge:-

1. Information for the innovations' technical characteristics, alternative ways to finance its adoption, and for the competitive advantages to be gained, were regarded as sufficient by adoptors as by non-adoptors.

2. Information regarding the R&D expenses spent and the after sales service to be provided were regarded as more sufficient by adoptors than be non-adoptors. The same holds

although not statistically significant for information about the image and credibility of the supplier.

3. Contrary to expectations, information about the industries' trends were regarded more sufficient by non-adoptors than by adoptors. However, as it is seen this has not prevented them from rejecting the innovations. This in turn, might be an indication that information provided by the supplier about the industry's trends carry less importance than other information in the decision process of potential adoptors - possibly because of their own perceptions about the industry.

Table 7.3.4. : Adoption response and information received from the supplier

VARIABLE : Information for technical characteristics

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	15.50	14.29	17,12	93.5	0.345 (X)

COMMENT: There is no difference between adoptors and non-adoptors regarding the sufficiency of information for the innovations' technical characteristics.

VARIABLE : Information for financing the adoption

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	14.88	15.17	17,12	100	0.463 (X)

COMMENT: There is no difference between adoptors and non-adoptors regarding the sufficiency of information regarding alternatives ways for financing the innovations' adoption.

VARIABLE : Information for competitive advantages

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	15.71	14.00	17,12	90.0	0.289 (X)

COMMENT: There is no difference between adoptors and non-adoptors regarding the competitive advantages to be gained by the adoption of the innovations.

VARIABLE : Information for industry's trends

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	12.82	18.08	17,12	65.0	0.045 (*X)

COMMENT: Contrary to our expectations, information for the industry's trends were regarded as more sufficient by the non-adoptors than by the adoptors.

Table 7.3.4. (Cont.)

VARIABLE : Information for supplier's image & credibility

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.88	12.33	17,12	70.0	0.070 (V)

COMMENT: Information regarding the suppliers' image and its credibility were regarded as more sufficient by the adoptors than by the non-adoptors.

VARIABLE : Information for R&D expenses spent

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.68	9.79	17,12	39.5	0.002 (*V)

COMMENT: Information for R&D expenses spent in the development of the innovations were regarded as more sufficient by the adoptors than by the non-adoptors.

VARIABLE : Information for after sales service

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.41	10.17	17,12	44.0	0.003 (*V)

COMMENT: Information for after sales service were regarded as more sufficient by the adoptors than by the non-adoptors.

Regarding the criteria used for the evaluation of the supplier, respondents were asked to indicate on a scale from 1 to 7, the extent of importance of a number of criteria, where 1: not important at all and 7: extremely important. Comparisons between adoptors and non-adoptors were made by the use of the Mann-Whitney U test and due to the exploratory nature of the investigation, a two-tailed test of significance was used (a = 0.10). The same test and level of significance was also applied for testing differences regarding the extent, (1 to 7), to which the use of specific risk reduction mechanisms increase their confidence in their decision to favor a supplier, (where 1: not at all and 7: to a great extent). The following tables 7.3.5. and 7.3.6. illustrate the relevant results from the above analysis.

Table 7.3.5. : Adoption response and importance of criteria used for the evaluation of the supplier

Criteria used for the Evaluation of the supplier	ADOPTERS	NON-ADOPTERS			
	MEAN RANK		CASES	U	SIG.
1. His reputation in the market place	12.03	19.21	17,12	51.5	0.016 (*)
2. Ease of communication with him	16.94	12.25	17,12	69.0	0.083 (*)
3. Technical progressiveness	15.68	14.04	17,12	90.5	0.584 (-)
4. Financial position	15.26	14.63	17,12	97.5	0.838 (-)
5. Quality of management	13.47	17.17	17,12	76.0	0.237 (-)
6. Past experience with the company	13.71	16.83	17,12	80.0	0.292 (-)
7. After sales service	15.74	13.96	17,12	89.5	0.501 (-)
8. Geographical proximity	17.15	11.96	17,12	65.5	0.096 (*)

Table 7.3.6. : Adoption response and methods used for the reduction of the perceived risk

Method used for the reduction of risk	ADOPTERS	NON-ADOPTERS			
	MEAN RANK		CASES	U	SIG.
1. Visiting the operations of the potential supplier to observe its viability firsthand	16.44	12.96	17,12	77.5	0.266 (-)
2. Visiting and questioning customers of the potential supplier	16.94	12.25	17,12	69.0	0.125 (-)
3. Obtaining contract of penalty clause provisions from the potential supplier	16.91	12.29	17,12	69.5	0.141 (-)
4. In choosing a supplier, you favor firms that your company has done business with in the past	13.53	17.08	17,12	77.0	0.248 (-)
5. Limiting the search of a potential supplier to only well known firms	12.65	18.33	17,12	62.0	0.066 (*)
6. Obtaining the opinion of the majority of your co-workers that the chosen vendor is satisfactory	18.76	9.67	17,12	38.0	0.033 (*)
7. Trial of the product for a small period of time within the firm	15.26	14.63	17,12	97.5	0.834 (-)

As it can be seen from the tables above, there are not many significant differences between adoptors and non-adoptors regarding the criteria and the methods used for the evaluation of the suppliers and the reduction of risk respectively. The significant differences between the two groups are concentrated on the following issues:-

1. The reputation of the supplier in the market place. Data indicate that this is regarded as being of more importance by non-adoptors than by adoptors.

2. Ease of communication with the supplier and his geographical proximity to the adopting unit. Data indicate that these criteria are regarded as more important by adoptors than by non-adoptors.

3. Limiting the search of a potential supplier to only well-known firms. Results show that use of this method is capable of increasing to a greater extent the confidence of non-adoptors rather than that of adoptors.

4. Obtaining the opinion of the majority of co-workers that the chosen vendor is satisfactory. Results show that use of this method is capable of increasing to a greater extent the confidence of adoptors rather than that of non-adoptors.

7.3.5. <u>THE STRENGTH OF THE RELATIONSHIP BETWEEN ADOPTION RESPONSE AND CHARACTERISTICS OF INNOVATIONS</u>

The analysis presented already in this section has identified the relationship between adoption response and perceived innovations characteristics, perceived risk and perceived sufficiency of information provided by the supplier. However, up to this point the analysis has not indicated whether this relationship is strong or an important one.

To this end, the strength of the relationship between adoption response, as the dependent variable, and each of the independent variables is illustrated in the following table 7.3.7. The correlation coefficient employed for testing the strength of these relationships is the Kendall's Tau in accordance with the discussion in Chapter 6. As it can be seen from the following table 7.3.6., the correlation analysis supports those hypotheses which also have been supported by means of the Mann-Whitney U test.

<u>Table 7.3.7</u>: Correlation coefficient for each of the independent variables with the dependent variable adoption of each innovation.

Variable	Kendal's Tau (Sig.)	Cases	Explanatory Comment
Perceived attributes total score	0.5951 (0.000) (*V)	29	The greater the extent to which an innovation is regarded by a firm as possessing a number of attributes the more likely it is that firm to be an adopter than a non-adoptor.
Perceived confidence	0.5353 (0.000) (*V)	29	The higher the perceived confidence of a firm in the adoption decision the more likely it is that firm to be an adoptor than a non-adoptor.

(Cont.)

Information for technical characteristics of the innovation	0.0706 (0.172) (X)	29	Adoption is inconclusively related with the perceived sufficiency of information for technical attributes provided by the supplier.
Information for financing the adoption	-0.015 (0.145) (X)	29	Adoption is inconclusively related with the perceived sufficiency of information provided by the supplier for competitive advantages to be gained.
Information for competitive advantages	0.0945 (0.145) (X)	29	Adoption is inconclusively related with the perceived sufficiency of information provided by the supplier for the financing of the adoption.
Information for industry trends	-0.289 (0.023) (X)	29	Adoption is inconclusively related with the perceived sufficiency of information provided by the supplier for the industry's trends.
Information for supplier's image and credibility	0.2545 (0.035) (*V)	29	Adoption is directly connected with the perceived sufficiency of information provided by the supplier regarding his image and credibility.
Information for R&D expenses spent	0.4892 (0.001) (*V)	29	The higher a firm perceives as being sufficient the information provided by the supplier regarding the R&D expenses spent, the more likely it is that firm to be an adoptor rather than a non-adoptor.
Information for after sales services	0.4540 (0.002) (*V)	29	The higher a firm perceives as being sufficient the information provided by the supplier regarding the after sales services to be offered, the more likely it is that firm to be an adoptor rather than a non-adoptor.

The present section has investigated the influence of innovations' characteristics and perceived risk on the adoption response of firms. The next section (7.4) will examine the influence of industry specific factors on the adoption response of firms in the present study.

Section 7.4. *: THE INFLUENCE OF INDUSTRY SPECIFIC FACTORS UPON ADOPTION RESPONSE*

7.4.1. INTRODUCTION

The influential role of factors relevant to firms' external environment upon the adoption of innovations was documented in chapter 5. In that chapter, it was also indicated that the external environment is a multi- dimensional concept (Duncan 1972) and its components were assessed alongside the relevant literature pertaining to each of them. Furthermore, in chapter 5, it was postulated the need for a more holistic research approach. To this end, a simultaneous investigation of aspects from all the components of the external environment was proposed.

Taking this as a basis, it was decided to investigate further a number of issues relevant to the components of the external environment as they have been identified in chapter 5 i.e. customers component, socio-political, competitors, communication, technological and suppliers component. While the last of these components has been already examined in sections 7.2 & 7.3 of this thesis, the remaining components will be investigated here. As such, the results relating to these issues will be presented in the following sequence:-

a) Competitors component.
  a1) new firms entry rate
  a2) competition
b) Technological component.
  b1) new product introduction
  b2) technological challenges in raw materials, machinery and production methods
c) Customers component.
d) Communications component.
e) Socio-political component.

7.4.2 COMPETITORS COMPONENT

7.4.2.1. NEW FIRMS ENTRY RATE

Entry of new firms in a market has been regarded as a major threat for the already established firms, and as an incentive for erecting barriers to entry for new firms. In that respect, among other, the adoption of technological innovations has been associated with the attempts of established firms to create and sustain such barriers (Levin 1978). In order to investigate further this issue, respondents from the firms participating in this study were asked to indicate on a scale from 1 to 7 the new firms' entry rate in their industries, where 1: very slow and 7: very fast.

The link between adoption response and new firms' entry rate is illustra-ted in the following table 7.4.1. This table indicates that there exists a statistically significant difference between adoptors and non-adoptors in their perceptions regarding the rate of new firms' entry in their industries. More specifically adoptors perceive a faster rate of entry than do non-adoptors.

<u>Table 7.4.1.</u>: New firms entry rate in the industries of adoptors and non-adoptors

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.38	10.21	17,12	44.5	0.004 (*V)

<u>COMMENT</u>: Adopters perceive that new firms are entering their industries faster than do non-adopters.

Overall, results from table 7.4.1 support the work of other researchers who have illustrated the new firms entry as an incentive for the established firms to adopt innovations and who have found that the rate of adoption and diffusion of innovations, as well as R&D activities, were faster and higher in industries where entry of new firms were not totally blocked (Comanor 1967, Globerman 1975).

In an attempt to gain more insights into the reasons underlying the afforementioned rate of new firms' entry respondents were further asked to explain why new firms are or are not entering their industries. Their responses are illustrated in the following table 7.4.2. As it can be seen from this table, a number of reasons have been cited which include both barriers and incentives to new firms, as well as opportunities for avoiding barriers to entry.

Of great interest is the fact, that increasing demand has been the most frequently cited incentive for entry of new firms. This indicates a situation where the productive capacity of already established firms can no longer satisfy excessive demand which therefore, creates opportunities for new firms to enter the field. As such, the adoption in particular of the two productive machine tools (innovations No.1 & No.2) can be attributed to the efforts of the established firms for increasing their productive capacity. This is also confirmed by the reasons which have been stated by the adoptors when explaining their decision to adopt the innovations (Section 7.1.).

Table 7.4.2.: Reasons explaining the new firms' entry rate in the industries of adoptors and non-adoptors

	INNOVATION No.1										INNOVATION No.2										INNOVATION No.3								
Reasons	ADOPTERS						NON-ADOPTERS				ADOPTERS						NON-ADOPTERS				ADOPTERS					NON-ADOPTERS			
FIRMS	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4
Increasing demand		X	X	X	X	X		X			X	X	X	X							X	X		X	X				
High cost of machinery & equipment	X						X	X			X	X			X			X	X	X			X						X
Existence of large firms which dominated competition domestically & abroad	X						X	X	X	X					X		X						X			X	X	X	X
Lack of necessary technical expertise																	X	X					X			X	X	X	
New and developing industrial sector																					X	X		X	X				
Purchasing of second hand machinery		X		X									X	X															
Persns who leave large firms																					X	X		X		X			
Need for imports substitution		X	X													X						X							
The incentive for exports				X	X											X													
Ignorance of market conditions																	X												
Shrinking demand																	X												

7.4.2.2. *INTENSITY AND IMPORTANCE OF VARIOUS TYPES OF COMPETITION IN THE INDUSTRIES OF ADOPTORS AND NON-ADOPTORS*

The link between adoption response and new firms entry rate was established above. Whereas this can be regarded as an investigation of the influence of 'would-be' competitors, this section will attempt to investigate the influence upon the adoption response of the competitive forces that firms already realise in their industries.

Following the arguments raised in chapter 5, it was decided to investigate the influence of three types of competition namely: competition in price, competition in product characteristics and competition in promotional activities and distribution. To this end, respondents were asked to indicate on a scale from 1 to 5 the degree of intensity for each type of competition, (where 1: virtually no competition and 5: intense competition). However, as it was argued in chapter 7 competition is perceived in different ways by different firms. To this end, respondents were asked additionally to indicate on a scale from 1 to 5 the degree of importance of each type of competition to their firm's profitability, (where 1: not important at all and 5: of great importance). The results of the above two scales were then multiplied with each other thus, creating single indicators for each company regarding each type of competition. The value range of these indicators is from 1 to 25.

The above manipulation has enabled the assessment of the different types of competition both from the point of their intensity in the industry and their relative importance to each firm's profitability. Successively, the connection between the combined intensity and importance of each type of competition with the adoption response was investigated and the relative results are illustrated in the following table 7.4.3.

Table 7.4.3.: Intensity & importance of various types of competition between adoptors and non-adoptors

VARIABLE: Price competition.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	10.59	21.25	17,12	27.0	0.000 (*V)

COMMENT: Non-adopters perceive competition in price as more intense and important than do adopters.

VARIABLE: Competition in product characteristics

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.18	13.33	17,12	82.0	0.172 (V)

COMMENT: Results indicate, not significantly, that adopters perceive competition in product characteristics more intense and important than do non-adopters.

VARIABLE: Competition in promotional activities

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.09	13.46	17,12	83.5	0.184 (V)

COMMENT: Results indicate, not significantly, that adopters perceive competition in promotional activities and distribution services as more intense and important than non-adopters do.

From table 7.4.3. the following conclusions emerge:

1. Regarding competition in price, results indicate that it is perceived as being of lower intensity and importance by adoptors than by non-adoptors.

2. Regarding competition in product characteristics results indicate (but not significantly in the 95% confidence level) that adopters perceive competition in product characteristics as being more intense and important than do non-adopters.

3. Regarding competition in promotional activities and distribution/ services results indicate (again not significantly) that adopters perceive it as being more intense and important than do non-adopters.

These results confirm the hypothesis regarding price competition, and support Gatignon & Robertson's (1989) findings, where firms which have adopted laptop computers for their sales-force were found to be in industries without intense price competition.

However, results regarding competition in product characteristics and promotional activities & distribution/ services, although they provide some support to the relevant hypotheses of this study, they are inconclusive. This might suggest that the relationship between adoption of innovations and competition in product characteristics and/or promotional activities is curvilinear depending upon the length of the period between the point where such competitive conditions have been realised by firms and the point where corresponding actions have been decided and implemented. In other words, competition in product characteristics and/or promotional activities can act as an incentive for adopting innovations. However, the more the adoption is delayed, the more the financial performance of the individual firms will be deteriorating; and this will eventually act as a constraint to the adoption of innovations. Unfortunately, these data cannot explicitly test this argument. Indirectly, one can shed some light to that by referring to the results of section 7.5 where sales of non-adoptors, in comparison to that of adoptors, have been found depending on a smaller number of older products which can be regarded as an indication of the lack of reaction in the past to the competitive forces of the environment.

7.4.3. TECHNOLOGICAL COMPONENT

In chapter 5, it was reported the work of many researchers who have postulated that frequent technical change in the industry promotes the adoption of innovations by creating "an atmosphere conducive to even greater change" (Bright 1964, O'Neal et al. 1973).

However, following Utterback & Abernathy's (1975) arguments regarding the direction of the technical change in the industry, it was decided to assess technical change in two ways. Firstly, by the frequency by which new products are introduced in the industry, and secondly, by the technological challenges that a company is facing as it is reflected by the present technological condition of its production factors and the technological changes on these factor as they occur in the industry of that firm.

7.4.3.1. NEW PRODUCT INTRODUCTION IN THE INDUSTRY

According to the discussion in Chapter 5, the hypothesis developed here states that adopters are expected to be in industries with a more frequent introduction of new products than the industries in which non-adopters are. In order to test this hypothesis respondents were asked to indicate on a scale from 1 to 7 how frequently new product are introduced in their industry, (where 1: almost never and 7: very often). The link between new product introduction in the industry and adoption response is illustrated in the following table 7.4.4.

Table 7.4.4.: Rate of new product introduction in the industry

VARIABLE:Rate of new product introduction.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.09	13.46	17,12	83.5	0.184 (V)

COMMENT: There is no significant difference in the perceived rate of new product introduction between the industries of adoptors and non-adoptors.

Interestingly, results indicate that there is no significant difference between adoptors and non-adoptors in their perception of the rate of new product introduction in their industries. The inability of this indicator to distinguish adoptors from non-adoptors might reflect the different perceptions of firms of what actually constitutes a new product from their own point of view.

To gain more insights, respondents were asked to indicate on a scale from 1 to 7 how frequently the new products introduced in their industry differ from the existing ones on a number of issues which are as it follows:

New products differ from old ones regarding:	Mean frequencies of differences		
	Innovation 1	Innovation 2	Innovation 3
Raw materials	3.15	3.75	5.17
Machinery used in production	3.85	4.00	3.60
Production methods	2.00	4.00	2.90
Their components	3.00	----	5.45
Their uses	2.25	2.90	3.55

As it can be seen from this table respondents have indicated frequent differences of new products from the old ones however, on different issues depending upon the industry in which they belong. Since these differences are relevant mainly to production factors one can proceed to examine whether data confirm the hypothesis regarding differences between adoptors and non-adoptors on the technological challenges they face in their production factors.

7.4.3.2. TECHNOLOGICAL CHALLENGES IN RAW MATERIALS, MACHINERY AND PRODUCTION METHODS

In chapter 5 it was argued that technical change in production factors (raw materials, machinery and production methods) employed by firms in an industry, challenges (threats) their technological moderness. Furthermore, it was suggested that the ability of a firm to respond to these technological challenges depends upon its past record of efforts towards modernization which in turn is depicted on the technological status of its production factors. To this end a hypothesis was developed which states that taking into account the technical change in the industry, adoptors of new technological innovations as compared to non-adoptors, is expected to be firms with a better record of efforts towards modernization and therefore firms facing less technological challenges in the bulk of their production factors.

In order to test this hypothesis, the following procedure was followed for each production factor i.e. raw materials, machinery and production methods. Respondents were asked to indicate the percentage of their machinery which a) was technologically advanced, b) had started to get obsolete in a slow rate, c) had started to get obsolete in a fast rate and d) was already obsolete. To those four categories a weight coefficient was allocated which ranged from 1 (for the technologically advanced category) to 4 (for the already obsolete category). The ratings of the machinery were then aggregated. In this way a firm with a larger portion of obsolete machinery would score substantially more than a firm with a larger portion of technologically advanced machinery.

The results of the above manipulation were then multiplied by the rate of technological change in the industry of the firm, internationally, regarding the machinery. This was indicated by the respondents on a scale ranging from 1: very slow to 7: very fast technological change in the industry.

This approach, regarding the operationalization of the variable of technological challenges in relation to machinery (TCM) could be presented mathematically as it follows:

$$TCM = \frac{\sum_{i=1}^{n}(T_i * Z_i) * W}{100}$$

Where:
Zi = 1 if i=1 (i.e. for technologically advanced machinery)
2 if i=2 (i.e. for slowly obsolete machinery)
3 if i=3 (i.e. for fastly obsolete machinery)
4 if i=4 (i.e. for already obsolete machinery)
Ti = % of machinery which is technologically advanced i.e. i=1
% of machinery which becomes slowly obsolete i.e. i=2
% of machinery which becomes fastly obsolete i.e. i=3
% of machinery which is already obsolete i.e. i=4
W = 1 - 7 where: 1 = very slow technological change of machinery for the whole industry.
7 = very fast technological change of machinery for the whole industry.

The value range of this variable is from 1 to 28 and the same procedure was used for the operationalization of the variables technological challenges regarding raw materials and production methods used by each firm. On the basis of the above procedure the higher is the value of the above indicators for a firm the more the technological challenges faced by this firm.

The link between technological challenges and adoption response is illustrated in table 7.4.5 from which the following points can be made:-

1. Regarding technological challenges in raw materials results indicate significantly that they are higher in non-adopting firms than in adopting firms. This confirms the hypothesis and supports the view that actions taken in the past by adopting firms, enable them to meet the technological challenges in their industries more effectively than non-adopting firms.

2. Regarding technological challenges in machinery results indicate in accordance with the hypothesis that overall non-adoptors face significantly more challenges than adoptors do.

3. Regarding technological challenges in production methods, results confirm the hypothesis and indicate that significant differences exist among adoptors and non-adoptors, the non-adoptors facing more challenges than the adoptors.

Table 7.4.5 : Technological challenges in production factors.

VARIABLE:Technological challenges in raw materials.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	12.35	18.75	17,12	57.0	0.022 (*V)

COMMENT: Non-adopters face more technological challenges in raw materials than do adopters.

VARIABLE:Technological challenges in machinery.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	11.71	19.67	17,12	46.0	0.006 (*V)

COMMENT: Non-adopters face more technological challenges in machinery than do adopters.

VARIABLE:Technological challenges in production methods.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	12.26	18.88	17,12	55.5	0.018 (*V)

COMMENT: Non-adopters face more technological challenges in production methods than do adopters.

The above results support the work of other researchers who have found innovative or progressive firms to be more technologically advanced than non-progressive firms (Carter & Williams 1958).

Furthermore, results indicate that firms with an innovative behaviour in the past, are more likely to be adoptors of new innovations since, due to their close distance from the new technological advancements, they can keep themselves in pace with new technology with only incremental investments. In contrast, firms in a distance and with a large gap from new technology, need to invest heavily in order to modernise themselves. The latter makes adoption of new technology a difficult issue and depending upon the technological needs of each firm, it might delay adoption of an innovation especially when its efficient utilization depends upon the existence of other necessary compatible machinery. Such a case has been documented by Mansfield (1968b) and has been realised in the present study in section 7.1. as a reason of rejection of innovations No.1 and No.2.

7.4.4. CUSTOMER COMPONENT

The role of customers in initiating innovations and assisting in their development has been postulated by many researchers (Hippel 1977, Foxall 1989). However, as it was seen in chapter 5, the role of customers in the adoption of innovation remains largely unexplored. To this end, it was argued that an investigation of the customers' role in the adoption of innovations could provide useful insights if it concentrates on the following aspects: a) the demanding character of the customers which it was felt it is depicted upon the technical specifications that they require from the desired products, b) the customers' receptivity for new and high technology products and c) the suppliers' receptivity in responding to their customers requests which it was felt, it could be assessed by the degree of influence of customers' demands upon the adoption of new production technologies and upon the introduction of new products.

On the basis of the above, it was hypothesised that adopters of innovations as opposite to non-adopters would be in industries where their customers: a) require a higher level of technical specifications from the products, b) are more receptive to new and high technology products, and c) have influenced to a greater extent the adoption of new production technologies and the introduction of new products. In order to test these hypotheses, appropriate questions were formulated and were addressed to respondents on the basis of a scale from 1 to 7 which corresponded to the following issues: a) for the level of technical specifications (1:low level and 7:high level), b) for the receptivity of customers, (1:not receptive at all and 7:very receptive), and c) for the extent of the customers' influence, (1:not at all and 7:to a great extent). The link between the above aspects of the client population and adoption response is illustrated in the following table 7.4.6. As it can be seen, this table indicates that data provide support to all four above hypotheses.

Table 7.4.6 : Various aspects of customers

VARIABLE:Technical specifications demanded by market.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	12.29	9.28	17,12	38.5	0.130 (V)

COMMENT: Results indicate, not significantly, that adopters perceive their customers as more demanding technologically than do non-adopters.

VARIABLE:Market receptivity of technological innovation.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	13.38	7.83	17,12	25.5	0.017 (*V)

COMMENT: Adopters perceive their customers as more receptive to technological innovations than do non-adopters.

VARIABLE:New production technologies introduction due to customers' demands.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	15.5	11.45	17,12	59.5	0.094 (V)

COMMENT: Adopters perceive their introduction of new production technologies as being influenced to a greater extent by their customers' demands than non-adopters do.

VARIABLE:New product introduction due to customer demands.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.59	9.60	17,12	41.0	0.012 (*V)

COMMENT: Adopters perceive their introduction of new products as being influenced to a greater extent by their customers' demands than non-adopters do.

7.4.5. COMMUNICATION COMPONENT

Communication has been demonstrated by past research as a central ingredient of the adoption and diffusion process of innovations (Czepiel 1974). Furthermore, empirical evidence reviewed in Chapters 5 & 2 indicates that the innovative behaviour of firms is directly connected with their ability to maintain and sustain good communication channels with their environment. To this end, it was decided to investigate the communication activities of firms in this thesis with scientific and research institutions, similar firms in the industry and their own and potential customers.

On the basis of the above, different hypotheses were developed which conclusively stated that communication with research institutions, similar firms and customers is more evident & more frequent in innovative firms (adoptors) which also perceive it as easier, and of higher importance than non-innovative firms (non-adoptors) do. In order to test these hypotheses the following variable and measures were used: a) a dichotomous (0/1) in order to find whether firms maintain such communication, b) a scale from 1 to 7, which investigates the frequency of communication, where 1: very rarely and 7: very frequently, c) a scale from 1 to 7, which indicates the easiness of communication, where 1: very easy and 7: very difficult, and d) a scale from 1 to 7, which corresponds to the perceived importance attached to communication by the firm, where 1: of no importance at all and 7: of great importance.

The link between adoption response and the variables related to the communication activities of firms is illustrated in table 7.4.7. from which the following conclusions emerge.

1. Overall, a larger number of firms communicate with similar firms in their respective industries than with research institution and/or their customers. This is very interesting and can be partly explained by the relative absence of scientific and research institutions in Greece, and by the associating high cost of communicating with such institutions abroad. Furthermore, the relative low number of firms communicating with their customers can be attributed to the lack of a marketing department within these small firms responsible for the contact of customers and the collection of information from them (Section 7.6.). Having said that, it seems that firms try to overcome these difficulties by communicating with each other, thus sharing information about new technology and customers' requirements. Furthermore this indicates a kind of secretiveness absence in their industries which has been found by many researchers as a situation in favour of the development adoption and diffusion of innovations. Moreover results indicate that the majority of firms which have communication links with either research institutions, similar firms or customers, are firms which are adoptors of innovations rather than non-adoptors (this is more evident for communication with similar firms and customers).

2. Results indicate that adoptors have more frequent communication with similar firms and their customers than non-adopters have. However, regarding communication with research institutions although the results confirm the hypothesis, the relationship is not significant.

3. Regarding the question of how easy the communication is, results indicate again that adoptors perceive it as easier than non-adoptors do.

4. Finally regarding the importance attributed by firms to communication, table 7.4.7. indicates that adopters tend to perceive communication as more important than non-adopters.

Table 7.4.7 : Communication in the industry

A. Communication with scientific and research institutions

	YES	NO	TOTAL
Adopters	6 (35.3%)	11 (64.7%)	17 (100%)
Non-Adopters	3 (25%)	9 (75%)	12 (100%)

A.1. Communication frequency

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	5.67	3.67	6,3	5	0.128 (V)

A.2. Communication easiness

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	4.75	5.50	6,3	7.5	0.342 (V)

A.3. Communication importance

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	5.67	3.67	6,3	5	0.124 (V)

B. Communication with similar firms

	YES	NO	TOTAL
Adopters	14 (82.4%)	3 (17.6%)	17 (100%)
Non-Adopters	7 (58.3%)	5 (41.7%)	12 (100%)

B.1. Communication frequency

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	13.79	5.43	14,7	10	0.001 (*V)

B.2. Communication easiness

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	9.43	14.14	14,7	27	0.043 (*V)

B.3. Communication importance

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	12.68	7.64	14,7	25.5	0.034 (*V)

C. Communication with own and potential customers

	YES	NO	TOTAL
Adopters	9 (53.0%)	8 (47.0%)	17 (100%)
Non-Adopters	2 (16.7%)	10 (83.3%)	12 (100%)

C.1. Communication frequency

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	6.78	2.50	9,2	2	0.041 (*V)

C.2. Communication easiness

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	5.75	9.75	9,2	1.5	0.035 (*V)

C.3. Communication importance

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	6.28	4.75	9,2	6.5	0.223 (V)

7.4.6. SOCIO-POLITICAL COMPONENT

Government policies and activities have been identified as influencing the adoption of innovation by many researchers. Their work which has been reported in Chapter 5, has identified the mechanisms through which government policies can affect both, the development and the adoption of innovations. However, recent empirical findings (Rubenstein et al. 1977, Parkinson & Avlonitis 1986) suggest that innovative firms are more aware of governmental incentives than non-innovative firms and indicate that, with some exceptions, the general negative attitude of firms towards government incentives might explain why they are not used by them. Moreover in chapter 7 it was argued that government policies are expected to play a more significant role in the adoption of innovations by small firms that lack the financial resources of large firms. To this end it was hypothesised that adopters of innovations perceive a more favourable governmental attitude towards their industries than the non-adopters do. The link between perceived qovernmental attitude and adoption response is illustrated in the following table 7.4.8. Respondents were asked to indicate their perception of the government attitude on a scale from 1 to 7, (where 1: government attitude is negative to the adoption of technological innovation in our industry and 7: government attitude is very positive). As it can be seen results indicate significantly that adopters perceive the governmental attitude in their industries as more positive than non-adopters do.

Table 7.4.8 : Perceived governmental attitude

VARIABLE:Governmental attitude towards industry.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.94	9.42	17,12	35.0	0.001 (*V)

COMMENT: Adopters perceive governmental attitude towards their industries as more positive than non-adopters do.

However, the following two points are of great interest: a) only 9 (50.3%) firms used external financial help, bank loans, to adopt the innovations and when asked whether they would have adopted them without this help, they all responded positively although they mentioned that this might have delayed the adoption for some time, and b) when respondents were asked to indicate which governmental policies in their own opinion facilitate or impede the adoption of technological innovation, they all referred to negative factors rather than positive. Regarding the latter, the following factors were mentioned:

FACTORS	TIMES MENTIONED
High interest rates	24
Bureaucratic procedures	20
Delays in decision making	10
Lack of risk from banks	10
Loans on the basis of guarantees instead of business plan	4

7.4.7. __THE STRENGTH OF THE RELATIONSHIP BETWEEN ADOPTION RESPONSE & INDUSTRY SPECIFIC FACTORS__

The analysis presented already in this section has identified the industry specific factors which differentiate adoptors from non-adoptors. However up to this point the analysis has concentrated on whether a relationship exists between industry specific factors and adoption response, and not on whether this relationship is strong or an important one.

To this end the strength of the relationship between adoption response, as the dependent variable, and each of the independent variables which represent industry specific factors is illustrated in the following table 7.4.9

As it can be seen from table 7.4.9., the findings of the correlation analysis support the relevant hypotheses. Furthermore a comparison between these results and those generated by means of the Mann-Whitney U test, reveals that they are also consistent.

Table 7.4.9 : Correlation coefficient for each of the independent variables with the dependent variable adoption of each innovation

Variable	Kendal's Tau (Sig.)	Cases	Explanatory Comment
COMPETITORS COMPONENT			
New firms entry rate	0.4386 (0.005) (*V)	29	The higher it is perceived the entry rate of new firms in the industry the more confident we are that adoption will occur.
Intensity and importance of price competition	-0.5704 (0.000) (*V)	29	Adoption is more likely to take place in firms facing lower intensity and importance of price competition than in their counterparts.
Intensity and importance of competition in product characteristics	0.1647 (0.173) (V)	29	Adoption is directly connected with the intensity and importance of competition in product characteristics.
Intensity and importance of competition in promotional activities	0.1607 (0.410) (X)	29	Adoption is directly connected with the intensity and importance of competition in promotional activities.
TECHNOLOGICAL COMPONENT			
Rate of new product introduction	0.0383 (0.410) (X)	29	Adoption is inconclusively related with the rate of new product introduction in the industry.
Technological challenges in raw materials	-0.3209 (0.024) (*V)	29	A low level of technological challenges in raw materials is connected with innovative behaviour (adoption).
Technological challenges in machinery	-0.3951 (0.006) (*V)	29	A low level of technological challenges in machinery is connected with innovative behaviour (adoption).
Technological challenges in production methods	-0.3441 (0.018) (*V)	29	A low level of technological challenges in production methods is connected with innovative behaviour (adoption).
CUSTOMERS COMPONENT			
Technical specifications demanded by the market	0.2236 (0.131) (V)	21	Adoption is directly related with the level of technical specifications demanded by the market.
Market receptivity of technological innovations	0.4463 (0.016) (*V)	21	Adoption is more likely by firms facing a higher market receptivity of technological innovation rather than by their counterparts.
Introduction of new production technologies due to customers' demand	0.2394 (0.089) (*V)	27	The more a firm is responding to its customers' demands for better technical specifications the more likely it is to be an adopter rather than a non-adopter.

(Cont.)

Introduction of new products due to customers' demand	0.4012) (0.012) (*V)	27	The more a firm is responding to its customers' demands for new products the more likely it is to be an adopter rather than a non-adopter.
COMMUNICATION COMPONENT			
A. Communication with scientific institutions			
A1. Frequency	0.3698 (0.129) (V)	9	Frequent communication with scientific institutions, easy access to them and perceptions allocating high importance to this communication is connected more likely with adoption rather than with non-adoption
A2. Easiness	-0.1336 (0.342) (V)	9	
A3. Importance	0.3932 (0.124) (V)	9	
B. Communication with similar firms			
B1. Frequency	0.6329 (0.001) (*V)	21	Frequent communication with scientific institutions, easy access to them and perceptions allocating high importance to this communication is connected more likely with adoption rather than with non-adoption
B2. Easiness	-0.3503 (0.043) (*V)	21	
B3. Importance	0.3765 (0.034) (*V)	21	
C. Communication with customers			
C1. Frequency	0.5032 (0.042) (*V)	11	Frequent communication with scientific institutions, easy access to them and perceptions allocating high importance to this communication is connected more likely with adoption rather than with non-adoption
C2. Easiness	-0.5103 (0.036) (*V)	11	
C3. Importance	0.2406 (0.223) (V)	11	
SOCIO-POLITICAL COMPONENT			
Governmental attitude towards industry	0.5295 (0.001) (*V)	29	The more positive it is perceived by a firm the governmental attitude towards the industry the more likely it is that firm to be an adopter rather than a non-adopter

This section has examined the existence and strength of the relationship between adoption response and industry specific factors. These factors were related to the external environment of firms in the present study.

The next two sections will investigate the relationship between adoption response and factors relevant to the internal environment of firms. As it was reported in chapters 4 & 6, these factors are related to the technological and behavioural dimensions of the innovativeness of organizations.

More specifically, the following section 7.5 will explore the influence upon adoption response of the technological dimension of the innovativeness of organizations. As such, in accordance with the discussion in chapter 6, factors relevant to the production process and the products of the firm will be investigated.

Successively, section 7.6 will enquire into the behavioural dimension of the innovativeness of organizations and will examine the influence on adoption response of organizational and managerial aspects of a firm.

Section 7.5. *:THE INFLUENCE UPON ADOPTION RESPONSE OF FACTORS RELATED TO THE PRODUCTION AND THE PRODUCTS OF FIRMS*

7.5.1. INTRODUCTION

In the conceptual framework of this thesis, it was postulated that a firm's adoption response to innovation is influenced, among other things, by firm's internal specific factors which manifest its history of technological accumulation. Theoretical justification to the above was provided by the fact that a firm's past behaviour outlines, alongside its environment, its needs and capabilities (Dosi 1988, Burgelman & Rosenbloom 1989) which eventually influence to a great extent its activities and, therefore, its adoption response to innovation. Moreover, based on the work of Webster and Wind (1972), Dosi (1988), Nelson (1987), it was suggested that, consideration of issues related to a firm's technical core (machinery & equipment, products) could serve well, the identification of that firm's technological asymmetries and varieties and as such, the investigation of its influence upon the firm's adoption response to innovation.

More specifically, the following issues will be examined in this section:
a) capacity utilization rate
b) percentage of sales from new products and dependance of firms on few products and customers
c) investments for new technologies

7.5.2. CAPACITY UTILIZATION RATE

In chapter 4, it was reviewed the work of Mansfield (1968b) who postulated, among other things, that both high and low levels of capacity utilization impede the introduction of innovations. The arguments used by him were that: a) high levels of capacity utilization do not allow firms to experiment with new technology since such experimentation interferes with production schedules, and b) firms operating in low levels of capacity utilization face high risks, low profits and an uncertain future which contribute to their reluctance to engage themselves in further investment. However, it is peculiar that Mansfield acknowledges in the first of the above arguments the managerial concern to protect the production schedules whereas in the second argument, the managerial concern to tackle the future's uncertainties and to overcome present problems is not taken into account. Interestingly, as it was shown in chapter 4, a performance gap, i.e. a possible consequence of a low capacity utilization rate, induces the adoption of innovations (Duchesnau et al. 1979). Furthermore, one can argue that low profits and an uncertain future faced by a firm increases the essentiality of some innovations for that firm; a factor which has been found to be in favour of the adoption of these innovations (Baker & Parkinson 1976).

Armed with the arguments raised in the discussion of chapter 4, one can attribute, to a large extent, the above controversies to the fact that a qualitative research has not been undertaken regarding the causes of the so called economic factors. Past research on the adoption of innovations, provides little insights into what are the causes of a high or low capacity utilization, although these very reasons are the driving forces behind the firms' willingness or reluctance in adopting innovations. To this end, results presented already in section 7.1. highlighted, among other, the following issues:

1. The production capacity utilized by adopting firms in this study was defined by two factors i.e. the production capabilities of the already employed machinery or practices and the quantity demanded by customers. More specifically, for adoptors of the CNC BENDING MACHINE and the PACKAGING MACHINE the quantity demanded by customers exceeded the production capabilities of the firms which in turn necessitated the adoption of new machinery. Regarding adoptors of the SUPPLY SYSTEM, it was shown that they used to make their own supply systems because their needs which were dictated by their product sales were low. However, as their sales increased, they found themselves unable to cope with their needs for more and better supply systems. On the basis of the above, one can conclude that for the adopting firms, the high capacity utilization rate was a constraint to their attempts to take advantage of the increased demand for their products. The combination of these factors was then translated by them to an incentive and a necessity for new machinery which in turn, induced, alongside other factors, the adoption of the innovations.

2. Regarding non-adoptors of the CNC BENDING MACHINE, as it was shown in section 7.1., their low capacity utilization indicated cuts in production owing to their bad selling performance. This in turn was found to be acting as a constraint to any attempts to increase

their utilized capacity, or their capacity in general through the adoption of the above innovation since, it was doubtful that they could sell their production output. Uncertainty regarding sales volumes was also found as a factor impeding the adoption of the PACKAGING MACHINE. As it was shown in section 7.1. two non-adoptors of this innovation being unable to anticipate sales volumes attempted what was called 'a secured trial' by buying a used and cheaper packaging machine or by considering the alternative contract packaging of their products. In addition, it was found that one firm considered and rejected this innovation on grounds related to legal issues (EEC directives). This in turn, raises the issue of the inappropriateness of the existent capacity in coping with anticipated changes of the environment. On the basis of these results, a counter argument can be developed to that of Duchesnau's which states, that low capacity utilization rates will not lead by implication to adoption of innovations due to risks involved and the existence of alternative methods for increasing capacity. Moreover attempts to increase the capacity utilized by a firm are connected with other requirements (i.e. quality and other product specifications) which unless they are fulfilled by the innovation in question, they can act as constraints to its adoption.

Armed with the above insights, one can now proceed to examine the link between adoption and capacity utilization rates for the firms in the present sample. Since previous research has not provided any information as to which level of capacity utilization can be regarded as high or low, the following procedures were used. Firstly, respondents were asked to indicate the percentage of their capacity utilized by them during the last five years. The reported percentages were then normalised by the use of the common logarithm (Log10) and the pooled estimate of the t-test was used in order to investigate any differences between adoptors and non-adoptors. Secondly, respondents were asked to indicate on a scale from 1 to 7, to what extent the previously mentioned by them percentage of capacity utilization is lower or higher than that of similar firms, where 1: lower and 7: higher. Responses were then analysed by the use of the Mann-Whitney U test.

Results from the above two tests are illustrated in table 7.5.1., from which the following conclusions emerge. 1). The capacity utilization rate of the adoptors during the last 5 years is significantly higher than that of the non-adoptors. 2). In comparison with similar firms, the adoptors' capacity utilization is higher than it is the capacity utilization of the non-adoptors. These results coincide with the reasons for adoption or rejection stated by the adoptors and non-adoptors of the innovation.

Having established above the link between capacity utilization rate and adoption response, it was examined the type of production employed by firms participating in this study. It was found that the majority of firms were producing either technologically simple, or complex products in small, or large batches which sometimes were custom made. To this end, no difference was found between adoptors and non-adoptors. However, the fact that all innovations were oriented towards small firms without mass or continuous flow production, highlights the fact that some new technologies can be adopted better by small firms with the above production types rather than, by firms with a mass production process.

Table 7.5.1.: Capacity utilization and adoption response

VARIABLE: Capacity utilization rate

			Adopters	Non-Adopters			
F-value	SIG.	Estim..	Mean		Cases	t-test	SIG.
1.79	0.28	Pooled	1.88	1.78	17,12	-3.9	0.000 (*V)

COMMENT: Adoptors had a higher capacity utilization rate during the last 5 years than the non-adoptors did.

VARIABLE: Capacity utilization in comparison with similar firms

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.24	10.42	17,12	47.0	0.005 (*V)

COMMENT: In comparison with similar firms, the capacity utilization rate of adopting firms is higher than that of the non-adopting firms.

7.5.3. THE FIRMS' PRODUCTS AND ITS DEPENDANCE ON FEW PRODUCTS OR CUSTOMERS

According to past empirical evidence presented in chapter 4, a firm's earliness in adoption is positively associated with the percentage of its sales that come from new products (Abu-

Ismail 1976). This in turn can be attributed to the fact that: a) the introduction of new products by a firm imposes the adoption of either product or process innovations, and b) a high percentage of new products' sales indicates the firm's positive strategic orientation towards newness and change, which both are issues tightly connected with the adoption of innovations.

On the basis of the above, firms in this study were asked to indicate the percentage of their sales which can be attributed to products launched by them: a) within the last 2 years, b) between 2-5 years ago, and c) more than 5 years ago. In order to have an overall indicator of a firm's products newness, a weight coefficient was allocated to the above three categories which ranged from 1 to 3. The results of the above manipulation were then aggregated and divided by 100 according to the following mathematical formula.

$$\text{Product} \quad \text{Newness} = \frac{\sum_{i=1}^{3}(P_i * T_i)}{100}$$

Where
Pi = % of products launched within the last 2 years, i=3
% of products launched between 2-5 years ago, i=2
% of products launched more than 5 years ago, i=1
Ti = 3 if i=3
2 if i=2
1 if i=1

The value range of the above variable (Product newness) is from 1 to 3, and the higher is its value, the higher the product newness of a firm. This indicator was then used to test the link between product newness and adoption response. To this end, the separate estimate of the t-test was used since the assumption of equal variances was violated. As table 7.5.2. indicates, sales of non-adopting firms are based upon products older than those of the adopting firms.

Table 7.5.2.: Product newness and adoption response

VARIABLE: Product newness

			Adopters	Non-Adopters			
F-value	SIG.	Estim..	Mean		Cases	t-test	SIG.
1.42	0.051	Separ.	2.26	1.80	17,12	-2,3	0.013 (*V)

COMMENT: Sales of non-adopting firms are based upon older products than those of the adopting firms.

However, as it was noticed earlier in this section, the adoption of an innovation might cause delays and disruptions in the production process. On the basis of that, it was hypothesised that firms which depend on a small number of products and customers will be reluctant to adopt innovations since: a) dependance on few products increases the consequences of a failure in the adoption of innovations applicable on these products and, b) dependance on few customers increases the consequences of a customer's ceasing of transactions due to the delays caused by the adoption of an innovation. With regard to the latter, Wilson and Gorb (1983) have stated that "there is evidence that many small firms are highly dependant on relatively few large customers, which reduces their flexibility and adaptability to change" (p.26). However, dependance on few customers illustrates also the bargaining power of the customers and highlights their influential role in any adoption decision by the supplier. Therefore, the second part of the above hypothesis must be viewed as being contingent upon the innovative character of the customers and their willingness to promote the efforts of the supplier, to produce and deliver a better product, by suffering any possible delays due to the adoption and use of the innovation.

In order to test the above hypothesis, the following procedures were followed. Firstly, respondents were asked to indicate the percentage of their products that generate 80% of their sales turnover. These figures were then normalised by the use of the common logarithm (Log10) and the means of the adoptors and non-adoptors were compared by the use of the separate estimate of the t-test since, the F-test indicated that the variances of the two groups were significantly different from each other. The relevant results are illustrated in the following table 7.5.3. Secondly, respondents were asked to indicate on a scale from 1 to 7 the extent on which their firms depend upon its 10 largest customers, where 1: not at all and 7: to a great extent. Data were analysed by the use of the Mann-Whitney U test and its results are illustrated in table 7.5.3.

As it can be seen from this table, non-adoptors' generate their sales from fewer products than adoptors do. Moreover, results indicate that non-adoptors are more dependant upon few customers than their counterparts. In addition, it must be reminded here that in the previous section it was found that the introduction of new products by adoptors was influenced to a great extent by their customers' demands. The latter substantiates the adverse effects upon adoption of the dependance of non-adoptors upon few products and customers.

Table 7.5.3.: Adoption response and dependance upon few products and customers

VARIABLE:Dependance upon few products

			Adopters	Non-Adopters			
F-value	SIG.	Estim..	Mean		Cases	t-test	SIG.
2.76	0.064	Separ.	1.739	1.522	17,12	-3.7	0.000 (*V)

COMMENT: Results indicate significantly that the bulk of the non-adoptors sales turnover is generated by fewer products as compared to adoptors.

VARIABLE : Dependance upon few customer

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	13.18	17.58	17,12	71.0	0.081 (V)

COMMENT: Results indicate a tendency that, non-adoptors depend upon their 10 largest customers to a greater extent than adoptors do.

7.5.4. INVESTMENTS FOR NEW TECHNOLOGIES

As it was mentioned in chapter 5, the external technological environment of a firm creates either constraints, opportunities or threats to a firm depending upon, among other things, the technological and behavioural diversity of the firm in the past (Dosi 1988). Furthermore it was shown that a firm's prior record with innovations may determine its capabilities and motivation towards the adoption of innovation (Burgelman and Rosenbloom 1989, Dosi 1988). On the basis of the above, it was decided to investigate the firms' behaviour in the adoption of new technology, as it is depicted upon their investments for new technology during the last five years. To this end respondents were asked to indicate the percentage of their investments that have been deployed for the adoption of new technology during the last 5 years. Expecting a larger portion of investments by the adopting firms rather than by the non-adopting firms, the following procedures were undertaken: a) The percentage figures provided by respondents in the above question were normalised by the use of the common logarithm (Log10), b) the adoptors' and non-adoptors' means of the above normalised figures were then tested for differences by the use of a pooled estimated t-test, since the variances of the two groups were not significantly different.

Moreover, since the past record on innovation defines the capabilities of a firm in the future, both in adopting new technologies and in serving its customers needs, the author proceeded by asking the respondents to indicate the extent to which the present technological base of their firm can adequately fulfil the needs of its present and potential customers. To this end a scale from 1 to 7 was used, where 1: not at all and 7: to a great extent. In order to test the existence of differences between adoptors and non-adoptors the Mann-Whitney U test was used.

The results of the above tests are illustrated in the following table 7.5.4. and confirm the expectations that a) adoptors have allocated in the past a larger proportion of their investment towards the adoption of new technologies than the non-adoptors did and, b) the technological base of adoptors can fulfil the future demands of their present and potential customers to a greater extent than the technological base of non-adoptors does.

Table 7.5.4.: The firms' new technology and adoption response

VARIABLE:Investments for new technology

			Adopters	Non-Adopters			
F-value	SIG.	Estim..	Mean		Cases	t-test	SIG.
1.17	0.75	Pooled	1.65	1.46	17,12	-1.5	0.070 (V)

COMMENT: During the last 5 years adoptors have allocated a larger proportion of their investments for new technologies than the non-adoptors did.

VARIABLE: Adequacy of technological base

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.94	9.42	17,12	35.0	0.000 (*V)

COMMENT: Adoptors are capable of serving in the future the needs of their present and potential customers, by means of their technological base, to a greater extent than their counterparts (non-adoptors).

In order to gain more insights into the type of technologies adopted in the past by these firms, a list was compiled with the 'state of the art' technologies, applicable to a firm's production and organizational core, and respondents were asked to indicate whether they have adopted each of them or not. The relevant results are illustrated in the following table 7.5.5., where the symbol (X) is used to indicate the adoption of a specific technology by a firm.

Table 7.5.5.: The firms' new technology and adoption response

	INNOVATION No.1										INNOVATION No.2										INNOVATION No.3								
New Technologies Adopted	ADOPTERS						NON-ADOPTERS				ADOPTERS						NON-ADOPTERS				ADOPTERS					NON-ADOPTERS			
FIRMS	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	6	1	2	3	4	1	2	3	4	5	1	2	3	4
1. Batch data processing	X										X	X	X				X				X	X	X	X	X	X	X	X	X
2. On-line & real-time systems	X										X										X	X	X	X	X				
3. Numerical control (NC) machines	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4. Computer numerical control machines	X	X	X	X	X	X					X	X					X				X		X	X					
5. CAD/CAM, FMS, Robots	X																				X	X	X	X	X	X	X	X	X
6. Production's control systems	X																												
7. Management Information Systems	X																						X		X				
8. Decision Support Systems	X																												
9. Data Banks	X										X	X	X				X				X	X	X	X	X	X	X	X	X

As it can be seen from this table (7.5.5.), adoptors have adopted more new technologies than their counterparts. In addition, this table indicates that adoptors and non-adoptors of the Power supply system (No.3) have adopted in the past a larger number of innovations than their counterparts. However, the latter can be attributed to the higher technological level of the sector (electronics) in which these firms belong as compared to the rest of those firms which are in rather traditional sectors of the Greek industry.

7.5.5. *THE STRENGTH OF THE RELATIONSHIP BETWEEN ADOPTION RESPONSE & FACTORS RELATED TO THE PRODUCTION AND THE PRODUCTS OF THE FIRM*

The analysis presented already in this section has identified the relationship between adoption response and factors related to the production process and the products of firms. However, up to this point, the analysis has not indicated whether this relationship is strong or an important one.

To this end, the strength of the relationship between adoption response, as the dependent variable, and each of the independent variables is illustrated in the following table 7.5.6. As it can be seen from this table, correlation analysis supports those hypotheses which also have been supported by means of the Mann-Whitney U test and the t-test.

Table 7.5.6 : Correlation coefficient for each of the independent variables with the dependent variable adoption of each innovation

Variable	Kendall's Tau (Sig.)	Cases	Explanatory Comment
Capacity Utilization rate	0.5223 (0.000) (*V)	29	A high capacity utilization rate is related with adoption rather than with rejection of an appropriate innovation.
Capacity Utilization rate in comparison with similar firms	0.4678 (0.000) (*V)	29	Firms which in comparison with similar ones make use of a higher capacity utilization rate are expected to be adopters rather than non-adopters.
Sales due to new products	0.4290 (0.000) (*V)	29	The more a firm's sales are based upon new products, the more likely it is that firm to be an adoptor rather than a non-adoptor.
Dependance upon few products	0.5030 (0.006) (*V)	29	The more a firm is dependent upon few products, the more likely it is that firm to be a non-adoptor rather than an adoptor.
Dependance upon few customers	-0.350 (0.005) (*V)	29	The more a firm is dependent upon few customers, the more likely it is that firm to be a non-adoptor rather than an adoptor.
Investments for new technologies during the last 5 years	0.2795 (0.022) (*V)	29	The more a firm's investments in new technology during the last 5 years, the more likely it is that firm to be an adoptore.
Adequacy of firm's technological base	0.3568 (0.005) (*V)	29	A technological base which can adequately fulfil the present and future needs of a firm's customers is expected to be found in firms which have had a positive adoption response towards innovation in the past.

Section 7.6. :THE INFLUENCE UPON ADOPTION RESPONSE OF ORGANIZATIONAL AND MANAGERIAL ASPECTS

7.6.1. INTRODUCTION

The preceding section highlighted the way technological asymmetries and varieties among firms influence their adoption response. However, as it was shown in the methodological part of this thesis, behavioural diversities among firms influence too their response to innovations (Dosi 1988). As such, this study's conceptual framework postulated that organizational/ managerial aspects of firms are responsible for these behavioural diversities. To this end, ample theoretical and empirical evidence has been provided in chapter 4. By and large, this evidence suggests that organizational/ managerial factors create attitudes and internal environments conducive to innovation.

Armed with the above insights, it was decided to investigate further a number of organizational/managerial factors and their influence upon the adoption response of firms. More specifically, it was decided to investigate the following issues: a) the organizational structure of firms and the existence of functions that foster the adoption of innovation, b) the ability of organizations to generate information both from external and internal sources, c) the ability of firms to assimilate new technical knowledge, and d) the attitude of firms' managerial staff and other employees towards innovation.

7.6.2. RESEARCH AND DEVELOPMENT ACTIVITIES

The existence of an active R&D department in a firm has been associated in past research with the receptivity of this firm to technological innovations (Mansfield 1968). This has been justified with the argument that R&D efforts bring firms closer to new technological developments, thus increasing their awareness. On the basis of the above argument, it was decided to investigate the existence of such a department within the firms. Moreover, acknowledging a firm's alternative to collaborate with research institutions for the development of new products, it was decided to investigated these activities, as well as their perceived utility to the firm. To this end the following questions and procedures were used in order to assess the link between R&D activities and adoption response:-

1. Respondents were asked to indicate whether there is an R&D department in their firm. To this end the Chi-square test was used to test any differences between adoptors and non-adoptors. 2. Respondents in firms which had an R&D department were further asked to indicate the number of persons employed full-time in that, and the percentage of their sales turnover accounted by the R&D budget. Successively, percentages were normalized by the use of the common logarithm (Log10) and the t-test was used to assess any differences between adoptors and non-adoptors. 3. Finally, respondents were asked to indicate whether their firms collaborate with other research institutes for the development of new products or for other technical issues relative to R&D. Moreover, the utility of such collaborations was investigated by means of a scale from 1 to 7, (where 1: not at all useful and 7: collaboration was useful to a great extent). Successively, the relevant responses were analysed by the use of the chi-square test and the Mann-Whitney U test respectively.

Table 7.6.1. illustrates the results from the above analysis. As it can be seen, no significant differences exist between adoptors and non-adoptors. This in turn, can be attributed to the fact, that only a small number of firms do have a research and development department, or collaborate with research institutes. However, data indicate, that even firms which do engage in R&D activities, cannot be discriminated into adoptors or non-adoptors of technological innovations on the basis of that. Given the fact, that these firms are mainly firms in the electronics sector (adoptors or non-adoptors of the power supply system), the latter indicates that their developmental efforts are either imitative, or based upon their design competencies which are knowledge based.

Table 7.6.1.: Research & Development activities and adoption response

VARIABLE: Existence of an R&D department.

	YES	NO	TOTAL
Adopters	6 (35.3%)	11 (64.7%)	17 (100%)
Non-Adopters	4 (33.3%)	8 (66.7%)	12 (100%)

VARIABLE: Percentage of sales turnover accounted by the R&D budget.

F-value	SIG.	Estim..	Adopters	Non-Adopters	Cases	t-test	SIG.
			Mean				
6.54	0.153	Pooled	1.409	1.389	6,4	-0.2	0.442 (X)

COMMENT: There is no difference between adoptors and non-adoptors regarding the percentage of their sales turnover which is accounted by their R&D budget.

VARIABLE: Collaboration with research institutes.

	YES	NO	TOTAL
Adopters	5 (25.4%)	12 (70.6%)	17 (100%)
Non-Adopters	3 (25.0%)	9 (75.0%)	12 (100%)

VARIABLE: Utility of collaborations.

TEST	ADOPTERS	NON-ADOPTERS	CASES	U	SIGNIFICANCE
	MEAN RANK				
M-W	4.50	4.50	5,3	7.5	0.500 (X)

COMMENT: There is no difference between adoptors and non adoptors as it regards the perceived utility of collaborations with research institutions.

7.6.3. STRATEGIC PLANNING

In chapter 2, it was reported the work of many researchers who have postulated that innovation is a strategic issue. Moreover, in chapter 4, past empirical evidence has demonstrated that the innovative behaviour of a firm, is positively linked with its strategic planning activities (Baker 1975a, Abu-Ismail 1976). On the basis of such evidence, it was decided to investigate the existence of strategic planning within the firms of this study, and its linkage with their adoption behaviour. To this end, as table 7.6.2. illustrates, only 6 (35.3%) of the adoptors, develop strategic programmes which however, cover a period of only 1 to 3 years, and they are annually revised. As such, it is statistically difficult to assess their influence upon the adoption behaviour of firms. In contrast however, all non-adopting firms do not engage in such activity. Despite such differences, as table 7.6.3. indicates firms which are practising strategic planning do consider a variety of issues.

Table 7.6.2.: Adoption response and strategic planning

VARIABLE: Existence of strategic planning

	YES	NO	TOTAL
Adopters	6 (35.3%)	11 (64.7%)	17 (100%)
Non-Adopters	0 (0.0%)	12 (100%)	12 (100%)

Table 7.6.3.: Issues in strategic planning

	Issues in strategic planning	No. of firms
1	Definition of the company's product markets	4
2	Long term investments	6
3	Future sales volume	6
4	Return on investments	1
5	Cash flow/ liquidity of the firm	6
6	Forecast of market size and market share	5
7	R&D projects and expenses	3
8	Forecast of technological changes/developments	4
9	Forecast for future recruitment needs	5
10	Investment in new technologies	6

7.6.4. CENTRALIZATION AND FORMALIZATION

As it was shown throughout chapter 4,the linkage between adoption response and centralization and formalization has been examined by many researchers in the past. However, in the same chapter it was also shown the lack of consistency in their findings. This in turn, has initiated the investigation of these issues in the firms of our sample. In the absence of any universally acceptable technique for the quantitative assessment of these issues, it was decided to employ the scales developed by Hage & Aiken (1967,1971), mainly because of their acknowledged reliability, convergent and discriminant validity of many of their items (Dewar et al. 1980). Each of these scales includes a number of questions which aggregated produce a single score. However, according to Hage and Aiken (1967) the centralization scale has two subconstructs which indicate participation in decision making and hierarchy of authority respectively. Similarly, formalization is composed of three subconstructs i.e. job codification, rule observation and job specifity.

The reliability and validity of these constructs have been examined by Dewar et al. (1980) who concluded that the centralization scales were both reliable and valid, while the formalization scales were suffering from problems of either reliability of validity. The latter problems were attributed to the ambiguous or similar phrasing of some items of the scales. Therefore, on the basis of Dewar et al. suggestions, the scales were extensively tested with respondents in the field in order to clarify the questions thus, increasing the reliability and validity of the scales. Insights gained from this procedure enabled the author to rephrase appropriately some questions and to drop some items which were causing confusion due to their highly similar phrasing (See appendix C). Successively, the modified scales were used and their reliability was assessed by means of the Cronbach's a coefficient (Nie et al. 1975). This coefficient showed a value of 0.6541, 0.5336 and 0.8819 for the aggregated scales of participation in decision making, hierarchy of authority and formalization respectively. Given the reduced number of items in each scale and the lack of similarly phrased questions (Dewar et al.), the reliability of the scales used ranges from good (0.5336) to excellent (0.8819). Armed with the above insights, the following table 7.6.4. illustrates the relationship between adoption response and centralization, and formalization. From this table a number of conclusions emerge:-

1. Regarding participation, results indicate a tendency according to which employees of adopting firms have a higher participation in decision making than employees of non-adopting firms. However, descriptive statistics of this variable indicate that, despite such difference between adoptors and non-adoptors, the level of participation of low level employees in decision making is quite low both for adoptors and non-adoptors.

2. Regarding centralization, no significant difference was found between adoptors and non-adoptors. Moreover descriptive statistics indicate that the level of centralization is quite high[23] for both adoptors and non-adoptors.

Although the above results do not confirm the hypotheses, they are consistent with findings of many researchers in small-sized firms, who have maintained that such firms are characterized by a high degree of centralization (Koehler & Tebbe 1985, Carson 1985).

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[23] With a maximum score or 15, 16, and 40 for the scale of participation, hierarchy and formalization respectively, the mean scores found were 3.83, 11.91, 20,25 for the non-adoptors, and 4.47, 11.23, 26.62 for the adoptors respectively. In the absence of comparative data this remark must be received cautiously.

3. Regarding formalization, results indicate contrary to expectations, that its level is significantly higher in adoptors than in non-adoptors. As it was shown in chapter 6, this surprising finding was encountered too by other researchers in the past. The explanation given by them was that a high degree of formalization, impedes the initiation stage of innovation adoption but it facilitates its evaluation & implementation stage (Zaltman et al.1973).

Table 7.6.4.: Centralization, formalization and adoption response

VARIABLE: Centralization (Participation in decision making).

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.56	12.79	17,12	75.5	0.109 (V)

COMMENT: Results regarding participation in decision making do not indicate any significant difference between adoptors and non-adoptors.

VARIABLE: Centralization (Hierarchy of authority).

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	13.32	17.38	17,12	73.5	0.097 (V)

COMMENT: Results regarding centralization do not indicate any significant difference between adoptors and non-adoptors.

VARIABLE: Formalization.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.71	9.75	17,12	39.0	0.002 (*X)

COMMENT: Contrary to expectations, results indicate that formalization of adoptors is higher than that of non-adoptors.

However, discussions with respondents in adopting firms, by means of follow-up interviews, revealed to the author a different perspective.

Accordingly, three key factors were found responsible for the high degree of centralization and formalization, i.e. ownership - control - time. More specifically, ownership and control was depicted in statements of the type, "it is my firm and nobody knows and cares for it the way I do". Again, control and time was depicted in statements of the type "I want to visit as many domestic and international exhibitions as I can, but there is no time, since if you leave them (employees) unattendant, they are capable of messing up everything". To this end, while high centralization was used to satisfy the owners' feeling of ownership and need for control, it also occupied most of their available time thus, leaving no spare time for activities which are capable of advancing their awareness of innovations. The latter was made capable by the use of formalized techniques (i.e. job specification, rules and procedures to be followed) which warranted the smooth running of the firm even in the absence of the owner.

Given the widely acclaimed innovative and risky character of small firms' owners (Rothwell 1983), the insights provided above describe a situation where owners were capable, through centralization, to maintain the standards of quality and delivery dates of their firm and at the same time to act as promotors of innovations by power (Koehler & Tebbe 1985). Moreover, through formalization, they were capable of further enhancing the above without their everyday presence in the firm thus, allowing themselves time for activities such as contacting their customers and suppliers or visiting domestic and international trade shows and exhibitions. Clearly, the latter have been found promoting the awareness of innovation.

7.6.5. ORGANIZATIONAL OPENNESS AND INFORMATION GENERATING MECHANISMS

As it was mentioned in the introduction of this section, the organisational structure of firms can assist the adoption of innovation by enabling the flow of information from sources both outside and inside the firm. To this end, it was decided to investigate the frequency of proposals for the introduction of new products from sources outside and inside the firms of adoptors and non-adoptors. Table 7.6.5 illustrates the results of the above investigation and confirms the hypotheses that adopting firms are characterized by an organizational structure which is open to ideas from outside and inside sources. This in turn, supports the work of other researchers who found that efficient communication and ability to generate information assist the adoption of innovation (Carter & Williams 1958, Martilla 1971, Czepiel 1974, Robertson & Gatignon 1986). Furthermore, in connection with previous findings in this section and section 7.4, where no difference was found in the collaboration of firms with market and research institution, results here indicate that innovative firms in this study use alternative methods for seeking information and ideas for the introduction of new products. This is accomplished firstly, by maintaining an open and receptive character to ideas generated outside the firm (e.g. customers) and secondly, by utilizing their own manpower as a source of new knowledge and ideas. The latter is very important, since a firm's employees share invaluable knowledge of its internal and external affairs, which in turn, provide them the ability to make proposals sound to the company's objectives and closer to its technology/ production and marketing capabilities.

Table 7.6.5.: Adoption response and information for the introduction of innovative products from sources outside and inside the firm

VARIABLE: Frequency of proposals from outside sources for the introduction of innovative products.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	17.00	12.17	17,12	68	0.059 (V)

COMMENT: Results indicate that adopters receive more proposals from outside sources than non-adopters do.

VARIABLE: Frequency of proposals from employees for the introduction of innovative products.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.56	9.96	17,12	41.5	0.002 (*V)

COMMENT: Results indicate that adoptors receive more proposals from their employees than non-adoptors do.

7.6.6. RECRUITMENT POLICY AND ENCOURAGEMENT OF SCIENTIFIC AND PROFESSIONAL ACTIVITIES

Carter and Williams (1958), Cohn (1980), Baker (1975a), Abu-Ismail (1976), found, among others, that innovative firms were characterized by sound and progressive recruitment and training policies. Based on this evidence, it was decided to investigate the existence of a formal recruitment policy within the firms of this study. Moreover, it was decided to investigate whether firms were encouraging outside professional and scientific activities of their employees; such activities have been found enhancing the ability of people "to stay abreast of recent development in one's field" (Freeman 1973). The latter was operationalised by the use of a scale from 1 to 7, where 1: the firm does not encourage the specific activity, and 7: the firm encourages to a great extent the activity in question.

Table 7.6.6. illustrates the results of the above investigation. From this table the following conclusions emerge:

1. A considerably larger number of adopters rather than non-adopters have a formal recruitment policy. From insights provided by respondents in adopting firms, this policy, for managerial posts, was oriented towards the recruitment of well-educated and experienced people and whenever they appear. For the technical staff, especially for firms belonging in the electronics sector, this policy dictated the search and recruitment of people recently graduated from technical colleges or universities, who despite their lack of experience were talented. Moreover, care was taken, so as the specialties employed to be compatible with the scientific fields in which the firm intended to enter.

In contrast, non-adopting firms were found to be hardly recruiting new managerial staff. Regarding technical staff, their approach was more reactive in the sense that they were waiting for a need to appear and then to make public their interest to employ a person.

2. Overall, there is a greater tendency among adoptors rather than non-adoptors to encourage the participation of their people in domestic/ international conferences and professional/scientific associations. In addition, results indicate that this is more or less obvious in different sectors. The latter was explained on the basis of the relative lack of such conferences and associations in the field of firms' engagement. The usual form of encouragement was either to provide the fees for the membership in associations or the expenses for visiting international conferences. The latter was found to be affordable by the small firms in the present study, since during these conferences many suppliers were also participating and they were inviting and willing to pay almost all the expenses for a person to attend.

Table 7.6.6.: Adoption response, recruitment policy and encouragement of scientific and professional activities

VARIABLE: Existence of a formal recruitment policy

	YES	NO	TOTAL
Adopters	8 (47.1%)	9 (52.9%)	17 (100%)
Non-Adopters	2 (16.7%)	10 (83.3%)	12 (100%)

VARIABLE: Attendance of domestic scientific conferences

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.65	12.67	17,12	74.0	0.101 (V)

COMMENT: There is no significant difference between adoptors and non-adoptors in the support they offer to their employees regarding this activity.

VARIABLE: Attendance of international scientific conferences

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	18.38	10.21	17,12	44.5	0.004 (*V)

COMMENT: Adopters encourage to a greater extent their employees to attend international scientific conferences than non-adopters do

VARIABLE: Participation in scientific associations

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.21	13.29	17,12	81.5	0.172 (V)

COMMENT: There is no significant difference between adoptors and non-adoptors in the support they offer to their employees regarding this activity.

7.6.7. ATTITUDE OF PEOPLE TOWARDS INNOVATIONS

Hitherto, the present section has examined a number of organizational/ managerial practices relevant to the adoption of innovation. Moreover, by investigating any differences between adoptors and non-adoptors, it has established the relationship of a number of organizational/ managerial factors with the behavioural diversity (adoption response) of the firms. As it was noticed in the introduction of this section, the application of different organizational/ managerial practices among firms, was expected to have influenced the attitude of the staff and other employees of these firms towards the adoption of innovation.

Armed with the above insights, it was hypothesized that people in adopting firms will have developed a more favourable attitude towards innovation, than people in non-adopting firms. In order to test the validity of this hypothesis, respondents were asked to indicate on a scale from 1 to 7, how favourable is the attitude of their firm's managerial staff and employees towards the adoption of innovation; where 1: not favourable at all, and 7: very favourable. The following table 7.6.7 presents the results of this test, and as such, confirms the relevant hypotheses.

Table 7.6.7.: Adoption response and attitude of people towards innovation

VARIABLE: Attitude of top management towards innovation

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	17.68	11.21	17,12	56.5	0.018 (*V)

COMMENT: The management's attitude of adopters is more favourable towards the adoption of innovations than that of the non-adopters.

VARIABLE: Attitude of employees towards innovation

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	17.65	11.25	17,12	57.0	0.021 (*V)

COMMENT: Employees attitude in adopting firms is more favourable towards the adoption of innovations than that of the non-adopting firms.

7.6.8. THE STRENGTH OF THE RELATIONSHIP BETWEEN ADOPTION RESPONSE AND ORGANIZATIONAL/ MANAGERIAL ASPECT OF THE FIRM

The analysis presented already in this section has identified the organizational/managerial factors which differentiate adoptors from non-adoptors. However, up to this point, the analysis has concentrated on whether a relationship exists between organizational/managerial factors and adoption response and not on whether this relationship is strong or an important one.

To this end, the strength of the relationship between adoption response, as the dependent variable, and each of the independent variables which represent organizational and managerial factors is illustrated in the following table 7.6.8.

As it can be seen from table 7.6.8., the findings of the correlation analysis support the relevant hypotheses. Furthermore a comparison between these results and those generated by means of the Mann-Whitney U test and the t-test, reveals that they are also consistent.

Table 7.6.8 : Correlation coefficient for each of the independent variables with the dependent variable adoption of innovation

Variables	Kendall's Tau (Sig.)	Cases	Explanatory Comment
Existence of an R&D department	0.020 (0.229) (X)	29	The existence of an R&D department is inconclusively related with the adoption behaviour of our firms.
Collaboration with research institutions	0.048 (0.299) (X)	29	Collaboration with research institutions is inconclusively related with the adoption behaviour of our firms.
Participation in decision making	0.212 (0.054) (V)	29	A higher participation in decision making is more likely in firms that adopt innovations rather than in firms which do not adopt.
Hierarchy of authority	-0.220 (0.048) (V)	29	The higher the hierarchy of authority in a firm, the more likely it is that firm to be a non-adoptor rather than an adoptor.
Degree of formalization	0.440 (0.001) (*V)	29	Contrary to our expectations, a higher degree of formalization is positively linked with adoption of innovation.
Frequency of proposals for new products from outside sources	0.267 (0.029) (*V)	29	A high frequency of such proposals is linked positively with the adoption of innovations.
Frequency of proposals for new products from inside sources	0.467 (0.001) (*V)	29	A firm with a high frequency of such proposals is expected to be an adoptor of innovations rather than a non-adoptor.
Existence of a formal recruitment policy	0.314 (0.023) (*V)	29	Firms with formal recruitment policy are more likely to be adoptors rather than non-adoptors of innovations.
Encouragement to attend national scientific conferences	0.215 (0.051) (V)	29	Encouragement to attend national scientific conferences is related with adoption of innovation.
Encouragement to attend international scientific conferences	0.436 (0.002) (*V)	29	Firms which encourage their employees to attend international conferences, are more likely to be adoptors rather than non-adoptors.

(Cont.)

Encouragement to participate in professional and scientific associations	0.163 (0.086) (V)	29	Encouragement to participate in professional and scientific associations is related to adoption.
Attitude of managers towards innovation	0.356 (0.009) (*V)	29	A favourable attitude of managers towards innovation is strongly associated with adoption of innovation.
Attitude of employees towards innovation	0.341 (0.010) (*V)	29	A favourable attitude of employees towards innovation is strongly with adoption of innovation.

This section has assessed the influence upon adoption response of factors relevant to organizational and managerial aspects of the firm. These factors reflect the behavioural dimension of the innovativeness of organizations.

Up to this point, the different clusters of factors which affect the adoption response of firms towards innovations have been examined individually. As such, it has been identified what supply side factors, characteristics of innovations, factors related to the production and products of the firms, as well as what organizational and managerial factors have influenced the adoption response of firms in the present study. Moreover, the way in which these factors have influenced the adoption response of firms also has been assessed.

Nevertheless, another objective of the study was to assess the collective influence of all these clusters of factors upon the adoption response of firms in this study. The next section (7.7.) presents the investigation of the collective influence of these clusters. This investigation has resulted to a 'profile' of firms which have adopted the innovations in question as opposed to a group of firms which at the same point in time have rejected the same innovations.

Section 7.7. : PROFILING THE ADOPTER FIRMS

7.7.1. INTRODUCTION

The preceding sections of this chapter presented a bivariate analysis of the variables included in this study. This analysis involved the dependent variable adoption response (i.e. adoption or rejection) and a large number of independent variables which were hypothesized to have a direct influence upon it. As such, two issues were examined: 1. The existence of a relationship between adoption response and each independent variable. In doing so, it was used the Chi-square test, the Mann-Whitney U test and the t-test, depending upon various properties of the independent variables. 2. The strength of any identified relationship between adoption response and each independent variable. To this end, the Kendall's tau correlation coefficient was used.

An immediate result of the above analysis is that a 'pool' of variables has been identified which can be considered as 'profiling' those firms in this study with a positive adoption response (adoptors), as compared to firms with a negative adoption response (non-adoptors). Consequently, knowledge of the face value of these variables in situations similar to the ones examined in this study, is expected to enable the distinction (discrimination) of a firm as either adoptor or non-adoptor. However, such a task is largely undermined by the fact that each independent variable is capable of explaining only a small part of the adoption behaviour of firms in the study (in statistical terms: only part of the observed variance is shared by the two variables concerned). To this end, it was hypothesised that there exists a combination of independent variables which collectively are capable of discriminating more effectively firms in this study, as either adoptors or non-adoptors, than it is any independent variable alone, or any other combination of variables. In order to find such a combination, discriminant analysis was employed for reasons explained already in chapter 6.

Briefly, discriminant analysis is a technique for classifying objects, by a set of independent variables, into one of two or more mutually exclusive and exhaustive categories. According to Klecka (1980), the mathematical objective of discriminant analysis is to weigh and linearly combine the discriminating variables in some fashion so that the groups are forced to be as statistically distinct as possible. In discriminant analysis, each group (as measured by its centroid) is treated as a point and the discriminant function is a unique (orthogonal) dimension describing the location of that group relative to the other or others.

According to Crask and Perrault (1977), the use of discriminant analysis in marketing has been proved most beneficial for three major purposes: 1. for developing predictive models to 'classify' individuals into groups, 2. for 'profiling' characteristics of groups which are most dominant in terms of discriminant functions, 3. for identifying the major underlying dimensions of a large group of variables. Clearly, due to the small number of firms in this study, the use of discriminant analysis here, must be regarded as an attempt to develop a 'profile' of adoptors as compared to non-adoptors, rather than to develop a predictive model. Having said that, the remaining parts of this section will present the procedures followed to apply the discriminant analysis, its results and the conclusions emerging out of them. A detailed discussion of the properties underlying the use of discriminant analysis can be found in Appendix D.

7.7.2. CHOICE OF DISCRIMINATING VARIABLES

The variables chosen to enter the discriminant analysis where variables which, after the use of bivariate analysis, had the following properties:

1. A relatively high correlation with the dependent variable (adoption behaviour).

2. A relatively low inter-correlation with other already chosen independent variables thus, avoiding a high colinearity among the independent variables which could have resulted to unstable discriminant coefficients; and therefore, it would have been difficult to interpret the contribution of each variable to the overall discriminatory power of the discriminant function (Morrison 1969). In doing so, both bivariate correlation analysis and principal components factor analysis was used. These techniques revealed variables with a high colinearity and eventually enabled the choice of variables which could be used as representatives of others. However, it must be stated here that some authors argue that colinearity among independent variables is a sample property which is largely an irrelevant concern in discriminant analysis,

except where the correlations are so high that it is no longer possible to invert the dispersion matrices (Eisenbeis 1973,1977).

7.7.3. THE DISCRIMINANT FUNCTION

In order to derive the best discriminant function, the Wilks stepwise selection method was used. This method selects independent variables for entry into the analysis on the basis of their discriminating power. Its objective is to maximize the overall multivariate F ratio for the test of differences among group centroids. To this end, a variable enters the discriminant function when its partial F is sufficiently large, i.e. when the amount of centroid separation, added by this variable above and beyond the separation produced by the previously entered variables, is statistically significant. Moreover, the variables that maximize the overall multivariate F ratio also minimize Wilk' Lambda which is a measure of group discrimination. According to Klecka (1980) the Wilks stepwise selection method takes into account the differences between all the centroids and the cohesion (homogeneity) within the groups.

The results of the discriminant analysis are illustrated in table 7.7.1 which include the following indicators:

1. The independent variables which entered into the discriminant function at each step.
2. The Wilk's lambda of each discriminating variable. Lambda is an inverse measure of the discriminating power in each original variable which has not yet been removed by the selection of this variable into the discriminant function.
3. The eigenvalue of the canonical discriminant function. This is a measure of the relative importance of the discriminant function.
4. The canonical correlation. It is a measure of the function's ability to discriminate among the groups. In different terms the canonical correlation squared indicates the proportion of variance in the discriminant function explained by the groups.
5. The overall Wilks' lambda and its test of significance (Chi-square).
6. The standardized discriminant function coefficients and the descriptive statistics (mean and standard deviation) of each discriminating variable. Each standardized coefficient indicates

the relative contribution of its associated variable to the discriminant function. The sign of each coefficient indicates whether the variable is making a positive or negative contribution.

7. The Box's M test of the equality of covariance matrices. The test of significance used is Ho:equality exist and H1:no equality. Theory suggests that an equality of covariance matrices is a requirement for the legitimate use of the discriminant analysis.

8. The classification results of the discriminant function.

Table 7.7.1. :THE RESULTS OF THE DISCRIMINANT ANALYSIS

A. *SUMMARY TABLE*

VARIABLES PER STEP		Wilk's Lamba	Sig.
1. Risk perception	(RP)	0.062972	0.0005
2. New firms entry rate	(NFER)	0.48769	0.0001
3. Intensity & Importance of price competition	(PC)	0.31517	0.0000
4. Formality	(FORM)	0.23979	0.0000
5. Technological challenges in machinery	(TCM)	0.14940	0.0000
6. Capacity utilization rate	(CUR)	0.10301	0.0000

B. *CANONICAL DISCRIMINANT FUNCTION*

FCN	Eigenvalue	PCT of Variance	Canonical Correlation	Wilk's Lamba	Chi-Square	DF	Sig.
1	8.70817	100	0.9470	0.10301	54.551	6	0.0000

C. *STANDARDIZED COEFFICIENTS & DESCRIPTIVE STATISTICS*

Variables	Standardized Coefficients	Descriptive Statistics Mean	St. Deviation
1. (RP)	0.35411	4.56	1.416
2. (NFER)	1.36032	3.34	1.421
3. (PC)	-0.77915	17.75	6.151
4. (FORM)	0.92714	24.10	6.114
5. (TCM)	-0.97320	5.45	2.113
6. (CUR)	0.68646	4.58	1.211

D. *TEST OF EQUALITY OF COVARIANCE MATRIX*

BOX's M	Approximate F	Degrees of Freedom	Significance
21.425	0.75786	21 2056.8	0.7737

E. *THE CLASSIFICATION RESULTS OF THE DISCRIMINANT ANALYSIS*

Actual Group	No. of Cases	Predicted Group Membership	
1	12	12 (100%)	0 (0%)
2	17	0 (0%)	17 (100%)
Percent of Correctly Classified : 100%			

As is illustrated in table 7.7.1. the application of discriminant analysis has produced a very good discriminant function, i.e. high eigenvalue and canonical correlation, low overall Wilk's lambda. This function has distinguished adoptors from non-adoptors on the basis of the combined effects of six variables. As such, it achieved a 100% correct classification of the cases in this study, i.e. as either adoptors or non-adoptors. However it must be stated here that the latter must be viewed cautiously since: a) the cases which were classified were also used for the derivation of the discriminant function, and b) since the number of cases is small, each one has contributed significantly to the foundation of the discriminant function and as such, each case is strongly associated with the function itself. Therefore, the validation of the results of the discriminant analysis, although not restricted to small sample studies, becomes a critical issue (Crask and Perrault 1977, Frank et al. 1965, Morrison 1969).

7.7.4. THE VALIDATION OF THE DISCRIMINANT FUNCTION

According to Morrison (1969),after results from a discriminant analysis are obtained, there are three basic questions to ask: 1) Which independent variables are good discriminators? 2) How well do the independent variables discriminate among groups? and 3) What decision rule should be used for classifying individuals?

The third of the above questions needs estimates of misclassification costs in order to be answered. Since this is out of the scope of the present research an attempt was made to answer the first two of the above questions. To this end the analysis proceeded as follows.

7.7.4.1. Which independent variables are good discriminators?

In order to find which of the independent variables that entered the discriminant function are good discriminators, the following methods were used.

1. The conditional deletion method, as proposed by Eisenbeis et al.(1973). This method estimates the importance of each variable according to the residual Wilk's Lambda of the discriminant analysis when this variable is omitted from the group of variables in the discriminant function. The following table 7.7.2 illustrates the results of this method. As it can be seen from this table, although all variables have a considerable residual Wilk's lambda, the variable indicating the new firms entry rate in the industry of the potential adoptors, seems to be the most important discriminating factor between adoptors and non-adoptors.

Table 7.7.2: THE CONDITIONAL DELETION METHOD

VARIABLES		Residual Wilk's Lamba
1. Risk perception	(RP)	0.1152
2. New firms entry rate	(NFER)	0.3105
3. Intensity & Importance of price competition	(PC)	0.1625
4. Formality	(FORM)	0.1835
5. Technological challenges in machinery	(TCM)	0.1951
6. Capacity utilization rate	(CUR)	0.1493

2. Normalization of the standardized discriminant coefficients, as proposed by Morrison (1969). According to this method, discriminant's coefficients were normalized by multiplying them with the standard deviation of each variable in the discriminant analysis. Justification of this method is based upon the fact that discrimination is achieved on the basis of statistical distance between the two groups and statistical distances are measured in units of standard deviations. The results of this method are presented in table 7.7.3. It is interesting to note that the rate of new firms entry is again the most important discriminating factor.

Table 7.7.3: NORMALIZATION OF STANDARDIZED COEFFICIENTS

VARIABLES		Normalized Discriminant Coefficients
1. Risk perception	(RP)	0.43823
2. New firms entry rate	(NFER)	1.50263
3. Intensity & Importance of price competition	(PC)	-0.12128
4. Formality	(FORM)	1.08078
5. Technological challenges in machinery	(TCM)	1.04508
6. Capacity utilization rate	(CUR)	0.76529

3. Assessment of the stability of the discriminant coefficients. To this end, a Jackknife method was used. According to Crask and Perreault (1977), this method is particularly useful when a researcher is concerned with characterizing between group profiles or with the underlying dimensions that discriminate between groups.

Essentially, the Jacknife method enables the computation of a t-value for each discriminant coefficient which afterwards, can be compared with the critical value of t and thus, it can reveal which variables are true discriminators of the groups in question.

Table 7.7.4. illustrates the results obtained from this method. As it can be seen from this table, the rate of new firms entry (NFER) is again the most important of the true discriminators of the two groups, i.e. adoptors and non-adoptors.

7.7.4.2. How well do the independent variables discriminate among groups?

To this end the U-Method was used (Crask and Perrault 1977). In this method, one observation (case) is omitted from the sample and a discriminant function is calculated by using the remaining observations. This function then, is free from the influence of this individual case upon its calculation. Successively, the function is used to determine the group membership of the omitted observation. By repeating this process for all observations in the sample an estimate of misclassification can be obtained for the whole sample and for each group.

Table 7.7.4: THE JACKKNIFE RESULTS

ADJUSTED DISCRIMINANT AND JACKKNIFE COEFFICIENTS

DISCRIMINANT COEFFICIENTS

Cases Omitted	(RP)	(NFER)	(PC)	(FORM	(TCM)	(CUR)	Constant
0	0.309485	1.057446	-0.15566	0.176772	-0.49460	0.631954	-6.64408
1	0.252824	1.016549	-0.19800	0.198729	-0.59015	0.827346	-6.18956
2	0.308107	1.036254	-0.15490	0.178272	-0.47645	0.583929	-6.41848
3	0.315225	1.04876	-0.15265	0.176913	-0.47574	0.596415	-6.56802
4	0.299360	1.037603	-0.15303	0.174256	-0.48571	0.623350	-6.43590
5	0.292514	1.03899	-0.14370	0.182052	-0.49543	0.645266	-6.83541
6	0.342428	1.060303	-0.16555	0.173527	-0.45844	0.670010	-6.88652
7	0.298318	1.039031	-0.15234	0.175748	-0.48444	0.624387	-6.71498
8	0.335672	1.036224	-0.15475	0.179843	-0.51547	0.620762	-6.78313
9	0.255692	1.053499	-0.16673	0.165299	-0.50403	0.611052	-5.86317
10	0.344172	1.057847	-0.14773	0.188805	-0.49605	0.648912	-7.47757
11	0.281119	1.044687	-0.14970	0.174023	-0.53762	0.640376	-6.26295
12	0.302312	1.049006	-0.16423	0.167823	-0.49745	0.631511	-6.14645
13	0.309212	1.030242	-0.15044	0.175022	-0.49474	0.610532	-6.41962
14	0.294893	1.036162	-0.15422	0.173858	-0.48989	0.617350	-6.33233
15	0.301912	1.039187	-0.15346	0.174913	-0.48786	0.621042	-6.43074
16	0.511144	0.965558	-0.19134	0.168890	-0.38732	0.548850	-6.67257
17	0.298533	1.03672	-0.15206	0.173477	-0.48527	0.635652	-6.70200
18	0.319774	1.053494	-0.15856	0.165181	-0.49613	0.632638	-6.43250
19	0.291985	1.055542	-0.15665	0.176686	-0.48841	0.626725	-6.69514
20	0.315754	1.030928	-0.15090	0.172510	-0.48640	0.624923	-6.49251
21	0.363476	1.252903	-0.15010	0.191047	-0.56130	0.774971	-8.08109
22	0.252649	1.184209	-0.16924	0.176398	-0.48277	0.607434	-6.48359
23	0.303523	1.051564	-0.15396	0.175459	-0.49003	0.614176	-6.43333
24	0.297269	1.024538	-0.15957	0.166755	-0.47589	0.676356	-6.41097
25	0.362081	1.333734	-0.14457	0.263213	-0.66915	0.568776	-8.85092
26	0.304606	1.03998	-0.15233	0.173593	-0.48602	0.621857	-6.67293
27	0.309595	1.039243	-0.15129	0.173190	-0.48505	0.621026	-6.69772
28	0.282560	1.079258	-0.16161	0.172057	-0.48113	0.656728	-6.71894
29	0.330804	1.070495	-0.14777	0.165924	-0.47593	0.660795	-6.83847
X (Mean) Jackknife	0.313017	1.063534	-0.15729	0.178395	-0.49794	0.635971	-6.68785
Coefficient	0.210556	0.886958	-0.10992	0.131308	-0.40092	0.519475	-5.41848
St.D.	1.293929	1.993729	0.333552	0.493499	1.286939	1.477478	15.97729
St.D. Error	0.240276	0.370226	0.061939	0.091640	0.238978	0.274360	2.966909
T-Value	0.876308	2.395719	-1.77468	1.432868	-1.67765	1.893400	-1.82630

According to the U-Method 96.5% of the total sample cases were correctly classified. Regarding the two groups, 91.6% of non-adoptors and 100% of adoptors were correctly classified as it is shown in the following diagram.

		CLASSIFIED AS		
		Non-Adopters	Adopters	
ACTUAL	Non-Adopters	11	1	12
	Adopters	0	17	17
		11	18	29

7.7.5. CONCLUDING REMARKS

The preceding analysis offers a discriminating profile of adoptors of technological innovation as firms which, as compared to their counterparts non-adoptors, are functioning in a competitive environment characterized by a faster rate of entry of new firms and by a lower level of price competition's intensity; as firms which face lower technological challenges in their machinery and equipment; have a higher capacity utilization rate, a higher degree of organizational formality and, they are more confident for the credibility of the innovation's supplier, the technical characteristics of the innovation and the expected advantages to be gained by its adoption.

It is interesting to note that the most powerful discriminating variable between the groups of adoptors and non-adoptors has to do with the perceptions of new firms' rate of entry in the industry. The latter finding demonstrates the outstanding role of the presence of an 'external incentive or stimuli' for the adoption of innovation. As such, it lets credence to the findings of researchers who have concentrated much of their efforts on this specific area of innovation. Moreover, it supports the work of researchers who have postulated that technological innovations, are strongly associated with attempts by firms to sustain and create barriers to entry for new firms in their industry (Porter 1985). The paramount role of this factor in the adoption of innovation, must also be analysed, here, within the context of small firms. Since small firms operate in few markets and have few customers, the anticipated loss of an account due to a new entrant constitutes a strong incentive for undertaking actions towards protecting and enhancing their competitive position. The fact that this incentive is industry or environmentally driven, adds strength to the present conceptual framework which postulated the important role of industry or environment specific factors in the adoption of innovation.

However, results indicate that the incentive alone, is only a part of the profile of adoptors. Two other factors that appear of equal importance are the low technological challenges that firms face in their production machinery and the formality in their organizational structure. The former factor encompasses the rate of technical change in the industry and the technological condition of the machinery in hand. As such, it indicates that the history of technological accumulation in firms in this study, has created technological asymmetries in the sense that, given the technological changes in the industry, adopters are closer to the technological frontier than non-adopters. Therefore, they possess the necessary technological capability, in the form of artefacts (machinery and equipment), knowledge and experience, to incorporate in their firms new technological developments. Moreover, a higher organizational formality from adoptors rather than non-adoptors indicates the existence of behavioural diversities among firms. As it was shown previously in section 7.6, formality, as part of the organizational practices of small firms in the present study, preserves the efficient running of operations while providing time to the general manager of each firm for a wider search for technological innovation. Clearly, this part of the adoptors profile supports the work of Dosi (1988) and as such, the relevant part of the conceptual framework.

In addition, the projected profile of adoptors indicates that they face a low intensity of price competition and a capacity utilization rate which is higher than that of similar firms. These two factors reflect another dimension of firms capabilities. To this end, the latter factor indicates an efficient use of the firms' productive capacity (performance), while the former manifests the lack of conditions capable of depleting a firm's resources and thus, impeding adoption on economic considerations. It is also interesting to note here, that these two factors alongside the previously mentioned incentive, are strongly associated with the reasons for adoption explained by adopters in section 7.1., i.e. increase production capacity and meet competition in product quality and services (not price). This in turn, adds more strength to the claims of many researchers, that the study of innovative firms (adoptors or technologically progressive firms) by suppliers or other innovation producing units, can reveal the direction for new technological developments and the kind of innovations for which potential adoptors will show the higher receptivity (Hippel 1986).

Finally, adoptors are profiled as firms which are confident about the credibility of the innovation's supplier, the technical characteristics of the innovation and the expected advantages to be gained by its adoption. This profiling feature of adoptors portrays the degree of 'fit' of the innovation with the objectives, needs and capabilities of the adopter firm. Clearly, the innovation is perceived in its wide context i.e. with tangible and intangible characteristics; some characteristics stem from the innovation own technical nature and mode of operation, some are embodied to it by the nature of the supplying unit and some reflect the expectations of the adopting unit. As such, this part of the discriminant analysis supports the influential role of the innovation's characteristics and its supplier upon its adoption. The latter is also consistent with the findings of section 7.1. within the context of reasons stated for adoption or rejection of each innovation.

This section has assessed the collective effect upon adoption response of the clusters of factors which were examined in the present study and developed a profile of firms which adopted the innovations in question as compared to a group of firms which at the same point in time rejected the same innovations.

The next chapter will present the key findings of this study and will discuss their implications for theorists and practitioners. Its aim is to provide insights and directions for further research towards a greater understanding of the role of suppliers in the decision of firms to adopt or reject an innovation and its conceptual and applied context within the marketing discipline.

CHAPTER EIGHT

CONCLUSIONS AND IMPLICATIONS

8.1. INTRODUCTION

The overall aim of the present study was to investigate what factors and in what way, have influenced the decision of some firms to adopt an innovation by contrasting them to a group of companies which, at the same point in time, have rejected the same innovation.

More specifically, this study commenced with three objectives:

1. *To advance the current understanding of the supply side factors and their influence upon the adoption response of firms towards an innovation.*
2. *To assess the collective influence upon adoption response, of the factors which in the present study are hypothesized to impinge upon the decision of firms to adopt or reject an innovation.*
3. *To bring forward and use a methodology which will enable researchers to explore the entire innovation process in its continuous reality i.e. from idea generation to the actual adoption or rejection of the innovation in the market place.*

Has the study achieved its objectives? What suggestions for theory and practice can be made using the results of this study? The rest of this chapter will focus on answering these questions.

The first of the questions above will be dealt with in the first part of this chapter. Implications of the study's findings for the theory of innovation adoption will then be discussed. This will be followed by a discussion of implications for producers of innovations, potential adoptors and policy makers in light of the study's limitations. Recommendations for further research to be undertaken in this area will be presented at the end of the chapter.

8.2. DIMENSIONS OF THE STUDY & KEY FINDINGS

8.2.1. THE METHODOLOGICAL STEPS OF THE STUDY

The conduct of this study was guided by the development of a conceptual framework which attempted to integrate the traditional buyer orientated adoption paradigm with the emerging supplier orientated paradigm. As such, three blocks of factors that influence the adoption of industrial technological innovations were included in the framework. These are as follows:-

A. *Supply side factors.* This block included the innovations' pre-launch activities of the suppliers, as well as their activities during the adoption process of their innovations.

B. *Characteristics of innovations.* This block included the buyers' perceptions of the tangible and intangible characteristics of the innovations, as well as their perceived risk in the adoption decision.

C. *Buyers' side factors.* This block in turn, included factors both exogenous and endogenous to the prospective adopter firms. Exogenous factors were related to the environmental conditions that each firm was facing as a unit operating within an industrial sector. Firm's endogenous factors were associated with asymmetries and diversities in the technological and behavioural dimensions of a firm's innovativeness as they were manifested by their production's machinery & equipment, products, organizational/ managerial practices and attitude towards innovation.

In order to investigate the above issues, research was undertaken in Greece among a number of firms which were the respective producers, adopters or non-adopters of each of three technological innovations. These innovations were two machine tools i.e. a CNC bending machine, a packaging machine, and an industrial component i.e. a switching power supply system.

The research commenced with an in-depth inquiry of the development and marketing activities of the producers, as well as of the reasons for adoption or rejection of each innovation by adoptors and non-adoptors. Following, statistical comparisons were made between adoptors and non-adoptors on a large number of variables which have been previously identified by means of a review of past theoretical suggestions and empirical findings. Finally, an attempt was made to develop a profile of adopters as opposite to non-adopter firms in this study by means of discriminant analysis.

These methodological steps have enabled the investigation of both the supply and demand side in the innovation process and as such, the contrasting of the development with the adoption phase of the innovations in question. The latter has resulted to useful insights with regard to the question of the role of supplier's activities and their influence on the adoption response of firms. These findings are reported in the following section.

8.2.2. UNDERSTANDING THE ROLE OF SUPPLIERS

An important finding of the above exercise is that the adoption response of potential adopting firms towards an innovation is influenced to a great extent by the activities of the innovation's supplier. These activities were traced in three echelons which are tightly interrelated. These echelons are as follows:

1. ***The supplier's new product development activities.***
2. ***The supplier's new product marketing activities.***
3. ***The supplier's conduct of his corporate business.***

With regard to new product development activities, as it was shown in chapter 2 Robertson and Gatignon (1986) postulated that suppliers of an innovation affect its adoption and diffusion rate, among other things, through their actions when determining the characteristics of the innovation. The present study verified this assertion by investigating the reasons for adoption of the innovations given by the adopting firms. Moreover, the present study went one step further and revealed the suppliers' activities which enabled them to generate and develop technically successful innovations compatible with the real needs in the market. Briefly, these activities are related to:

A. The previous commercial activities of the innovating firms B. The participation of customers in the initiation and development of the innovation	Generation of ideas
C. Aligning the new product development with the technical strengths of the firm and its corporate objectives D. The existence of a product champion E. Using external technical help	Technical development

The above findings coincide as to those in the literature of the success and failure of innovations which have been reported in the second chapter of this thesis. As such, they add weight to the author's conjecture that our understanding of the innovation process and the role of suppliers can be advanced by integrating results from innovation studies which have focused on the supply side of innovations (suppliers) with those on the demand side of innovations (adoptors).

However, the present study has revealed two additional aspects of the development activities of innovation suppliers which also need to be taken into account.

Firstly, the New Product Development process is not only a testing ground of the ability of the firm to identify real market needs and/or technological opportunities and to translate them into new products. Also, owing to the inevitable and required participation of other firms and customers in this process, it becomes a testing ground of the ability of the firm's management to handle relationships with third parties. The three cases advanced in the present study reveal the following positive or negative consequences of the firms' efficiency in managing such relationships:

a). if the customer(s) who has participated in the development process is dissatisfied, he may diffuse onto the market negative information about the supplier and the product; this in turn will influence the adoption response of other firms, thus damaging the adoption and diffusion prospects of the innovation as well as of other innovations produced by that supplier (case of CNC bending machine).

b). if the relationship between the developing firm and its suppliers (e.g. suppliers of components) is not well managed, the firm might find itself experimenting with outdated components or components that the supplier has ceased to produce; this in turn will create technical problems and will undermine the confidence of potential adopters with regard to the existence of spare parts in case of any defaults in the future (case of packaging machine).

c). the ability of the firm to create and manage good relationships with its customers may be used as a marketing tool for its engagements in collaborations with new customers and the development and favourable acceptance of new products in the market place (case of power supply system).

A prominent conclusion from the above insights is that the innovation development process should be approached as a '***social event***' and as such its output and success should not be related only to the development of a technically successful new product but also to the development of relationships with third parties which, depending upon their nature, may assist or hamper the adoption prospects of the product in the market place. Consequently, the role of supplier in managing these relationships becomes of extreme importance.

Secondly, the study indicates that the locus of the firm's new product development activities extends beyond what has been conceptualised and framed as New Product Development Process (i.e. from idea generation to the prototype testing and the introduction of the product). It enters the period of the adoption and diffusion of the innovation as further development or modifications of the product. Its aim is to make the innovation more compatible with the operational conditions or specific needs of potential adoptors thus triggering a positive adoption response by them. Modifications of the product were evident in this study as means used by the suppliers for marketing their innovations.

However, the present study reveals that suppliers, in addition to the latter, assist or educate potential adoptors thus, adjusting their conditions to enable a profitable use of the innovation by them which in turn, invokes a positive adoption response towards the innovation. This ***educating role*** of suppliers should not be confused with the already projected in the literature role of suppliers whereby the adopter is taught the proper use of the innovation by the supplier. The educating role of suppliers in the present study is realized through the provision of 'side services' to the buyer such as, *technological* (i.e. how to solve technical problems when developing their products (case of P2 and P3), how to use new packaging material for their products (case of P2)), *commercial* (i.e. how to achieve exports (case of P1)) and *financial* (i.e. how to raise capital (all cases)) services, accrued mainly from their technological expertise and/or their industrial and commercial experience nationally or internationally.

Finally, the present study indicates that, alongside the supplier's new product development and marketing activities, the broader conduct of his corporate business has a crucial effect upon the adoption response of firms towards the innovation produced by this supplier. Here, the conduct of the corporate business was found acting as a mechanism for increasing or reducing the perceived risk of the potential adoptors in their decision to adopt or not an innovation. Clearly, this is an intangible aspect of the decision of firms to adopt or not an innovation.

Similarly, Levitt (1981) postulated that every new product has a degree of intangibility because unless the customer is in a position to fully test it before buying it, the only thing he gets is promises for future satisfaction. However, Levitt is still referring to the technical performance of the product. What about the promises for after sales services, the mute expectation that the supplier always will be there to assist overcoming any problems with the product, the expectation that the collaboration with the supplier will provide an opportunity for a technical window in the future, the expectation that the supplier will make his utmost to establish the innovation or the technology as a standard in the market place? A finding of the present study is that the supplier's conduct of his corporate business can project doubt or confidence in the adoption decision of potential adoptors. It can act as a mechanism undermining the trust of the potential adoptor to the supplier and by implication to the product or it can serve as an assurance for a good relationship in the future and that every care has been taken for the product to live up to his expectations. The former was found in the present study obstructing the adoption response of firms towards the innovations in question while the latter was found enhancing their adoption response. ***In other words the supplier's conduct of his corporate business is a critical mechanism for making tangible the intangible aspects surrounding the decision of firms to adopt or not an innovation.***

The conclusions above suggest that in terms of one of the objectives of the present study, new insights have been provided for understanding the role of suppliers and their influence upon the adoption response of firms towards an innovation. The implication of these findings will be discussed in detail later in this chapter.

In addition, the present study also has developed and tested a number of hypotheses with regard to specific factors (variables) which were expected to have impinged upon the decision of firms to adopt or reject an innovation. The next section will present findings with regard to the influence of each of these factors, as well as their collective impact on the adoption response of firms.

8.2.3. THE COLLECTIVE INFLUENCE OF FACTORS AFFECTING ADOPTION RESPONSE

Table 8.1 illustrates the variables which were examined in the present study and their relationship with the adoption response of firms towards an innovation.

Table 8.1.: Variables examined in this thesis, their relationship with adoption response & corresponding hypotheses.

Signs in this table denote the following:

+/- : a positive or negative influence upon adoption response

*V : the relationship between the variable and the adoption response is statistically significant and accords with the hypothesized one.

V : the relationship between the variable and the adoption response accords with the hypothesized one but is not significant statistically.

X : the relationship between the variable and the adoption response is different than the one hypothesized.

HYPOTHESES & RELATED VARIABLES		RELATIONSHIP	
A. BUYERS SIDE			
A.1. INDUSTRY SPECIFIC FACTORS			
A.1.1. COMPETITORS COMPONENT			
H.1	New Firms Entry Rate	+	(*V)
H.2	Intensity and importance of price competition	-	(*V)
H.3	Intensity and importance of competition in product characteristics	+	(V)
H.4	Intensity and importance of competition in promotional/service activities	+	(V)
A.1.2. TECHNOLOGICAL COMPONENT			
H.5	Rate of new product introduction	X	(X)
H.6	Technological challenges in raw materials	-	(*V)
H.7	Technological challenges in machinery	-	(*V)
H.8	Technological challenges in production methods	-	(*V)

(Cont.)

A.1.3. CUSTOMERS COMPONENT			
H.9	Technical specification demanded by the market	+	(V)
H.10	Market receptivity of technological innovation	+	(*V)
H.11	Introduction of new production technologies due to customers' demands	+	(*V)
H.12	Introduction of new products due to customers' demands	+	(*V)
A.1.4. COMMUNICATION COMPONENT			
H.13	A. Communication with scientific institutions		
	A.1. Frequency	+	(V)
	A.2. Easiness	+	(V)
	A.3. Importance	+	(V)
	B. Communication with similar firms		
	B.1. Frequency	+	(*V)
	B.2. Easiness	+	(*V)
	B.3. Importance	+	(*V)
	C. Communication with customers		
	C.1. Frequency	+	(*V)
	C.2. Easiness	+	(*V)
	C.3. Importance	+	(V)
A.1.5. SOCIO-POLITICAL COMPONENT			
H.14	Governmental attitude towards innovation	+	(*V)
A..2. PRODUCTION AND PRODUCT RELATED FACTORS			
H.15	Capacity utilization rate	+	(*X)
	Capacity utilization rate in comparison with similar firms	+	(*X)
H.16	Sales due to new products	+	(*V)
H.17	Dependance upon few products	-	(*V)
H.18	Dependance upon few customers	-	(*V)
H.19	Investment for new technologies during the last 5 years	+	(*V)
H.20	Adequacy of firm's technological base	+	(*V)
A.3. ORGANIZATIONAL AND MANAGERIAL FACTORS			
H.21	Existence of an R&D department	X	(X)
	Collaboration with research institutions	X	(X)
H.22	Existence of strategic planning	+	(V)
H.23	Participation in decision making	+	(V)
H.24	Hierarchy of authority	-	(V)
H.25	Degree of formalization	+	(*V)
H.26	Frequency of proposals for new products from outside sources	+	(*V)
	Frequency of proposals from inside sources	+	(*V)
H.27	Existence of formal recruitment policy	+	(*V)
H.28	Encouragement to attend national scientific conferences	+	(V)
	Encouragement to attend international scientific conferences	+	(*V)
	Encouragement to participate in professional and scientific associations	+	(V)
H.29	Attitude of managers towards innovation	+	(*V)
	Attitude of employees towards innovation	+	(*V)
B.1. INNOVATION CHARACTERISTICS AND PERCEIVED RISK			
H.30	Perceived attributes total score	+	(*V)
H.31	Perceived confidence	+	(*V)

(Cont.)

C.1. SUPPLY SIDE RELATED FACTORS			
	Information for technical characteristics	X	(X)
	Information for financing the adoption	X	(X)
	Information for competitive advantages	X	(X)
H.32	Information for industry trends	X	(X)
	Information for supplier's image & credibility	+	(V)
	Information for R&D expenses spent	+	(*V)
	Information for after-sales service	+	(*V)

In order to assess the collective impact of the above variables on the adoption response of firms in the present study, discriminant analysis was used. The results of this analysis enabled the development of a profile of adoptors as opposite to non-adoptors of the innovations in question.

Interestingly, the best discriminant function was composed of variables (characteristics) representing all main blocks of variables that have been postulated by the conceptual framework to influence the adoption response. As such, adoptors in comparison with non-adoptors, were profiled as firms which operate in a competitive environment characterized by a faster rate of entry of new firms and by a lower level of price competition; as firms which face lower technological challenges in their machinery and equipment; have a higher capacity utilization rate, a higher degree of organizational formality and, they are more confident of the credibility of the innovation's supplier, the technical characteristics of the innovation and the expected advantages to be gained from its adoption.

The results above indicate that the adoption response of firms is conditioned by a variety of factors and their interaction. The nature of these factors suggest that in any attempt to understand the factors impinging upon the decision of firms to adopt or not an innovation, neither the environment they face, nor their technological and organizational arrangements, or the characteristics of the innovation and the actions of the suppliers should be overlooked.

Overall it can be said that the present study has achieved its three main objectives. A conceptual framework and a methodology were developed which enabled the investigation of the entire innovation process i.e. from idea generation to the adoption of the innovation in the market place. The role of suppliers in this process was investigated in detail and useful insights were gained towards a greater understanding of their impact in the decision of firms to adopt or not an innovation. Finally, it was assessed the collective influence of the many variable which by means of the conceptual framework were hypothesized to impinge upon the decision of firms in the present study to adopt or not an innovation.

In the next section, the theoretical implications of the results found in the present study will be analysed in detail.

8.3. THEORETICAL IMPLICATIONS

Based on the fundamental premise that technological innovation is desirable and should be actively promoted (Mansfield 1968b, Baker 1975), scholars in a variety of disciplines have devoted considerable efforts to understand the process of innovation.

A critical factor for the success of this process is the widespread acceptance of the innovation in the market place. Researchers, recognizing that an early adoption of the innovation is essential for the success of the latter process, have rigorously attempted to identify the factors impinging upon the decision of some firms to make use of an innovation earlier than other firms.

By means of a literature review it was found that, in the marketing discipline researchers have addressed separately, the issues of development and adoption/diffusion of innovations in their attempts to find the 'recipe' for the successful innovation. However, both of the approaches above are incomplete, since they draw their conclusions from a dichotomized process which in essence, as argued in this thesis, should be more accurately conceptualized as one continuous process. Therefore, the focusing upon only one stage each time has undermined any attempt towards formulating a unified theory which can be used as a fulcrum to lever up the successful performance of technological innovations.

Moreover, with regard to the early adoption of an innovation, research has paid more attention to the influence, on the adoption response of firms, of factors relevant to the characteristics of the potential adopting units and the innovations. The influence of the supply side on the adoption response of firms has received, comparatively, little attention.

The empirical evidence which has been produced from the present study suggests that the conceptualization of the industrial adoption of innovation within the marketing discipline, will be advanced via an ***'integrated approach'***. That is, instead of concentrating alone on either the characteristics of potential adoptors or the activities of innovation suppliers, the marketing discipline should address both issues simultaneously. As such, the extant adoption paradigm, which is largely derived from the industrial buying behaviour discipline, is brought together with the emerging supply side paradigm.

The conceptual framework of this study can be perceived as a first attempt towards this direction. An immediate benefit from such a conception is that the adoption process becomes a scene of a ***'heuristic interplay'*** among suppliers and potential adoptors, rather than a *'monodrama'* where a single performer either seeks/receives information (adoptor), or sends information (supplier). Another benefit is that the continuous reality of the entire innovation process is taken into account. An epistemological gain of the latter for the theory of adoption of innovations is a relaxation of the current over-emphasis on the adopters of innovations. This in turn may lead to a more balanced consideration of both adopters and suppliers in the innovation process and as such, to a greater understanding of the role of the latter.

By following such a balanced approach the present study has extended the empirical literature (i.e. Gatignon and Robertson, 1989) on the role of supply side factors to the question of the adoption of industrial innovations. To this end, it was found how specific activities of suppliers have had a direct influence upon the adoption decision of potential adoptors of their innovations. Some of these activities were related to the efforts of suppliers to produce products with technical characteristics compatible with the needs, objectives, experience and expertise of potential adoptors. The relevance of these activities to the adoption response of firms has been confirmed, as mentioned earlier by several studies (see Ch.2), and has also been substantiated by the one reported here.

However activities were found to have influenced the adoption response of firms which give rise to the ***conceptualization of the product development process as a social event and not only as a technical exercise.*** This implies that the output of the development process should not be assessed only in technical terms. The management of the relationships developed among the parties participating in this process also bears consequences for the success or failure of the entire innovation process. In other words, theory should acknowledge that the quality of these relationships do not lead only to the development of a technically successful new product. In addition, they convey information to the market with regard to the product and the supplier thus, influencing the adoption response of firms and by implication the performance of the product in the market place.

Besides, other activities, such as credibility and image of a firm which will exist in the long run to assist the servicing of the innovation, and to cope with future technological developments (See Ch.7, sect. 7.1), although only implicitly linked with the development process, they also were found to have influenced the adoption response of potential adoptors. Clearly, these activities are connected with the conduct or management of the corporate business rather than with the conduct or management of the innovation development process alone.

For researchers of innovation within the marketing discipline, this means that they should expand their scope of investigation to include corporate activities other than those explicitly linked with the development process of innovations as factors influencing the innovations' performance in the market place. ***In other words, the conduct of the innovation process and its success should not be seen in isolation of the conduct of the corporate business.***

In addition, it was found that suppliers in their attempts to market their innovation were engaging themselves in further developmental activities i.e. modification of the products according to customers' requests (See Ch.7, sections 7.1 & 7.2).

There is an opportunity here for the theory of adoption and diffusion to overcome some of its deficiencies identified by Gold (1981) who stated that, changes in the rates of innovation adoption, might be a result of significant improvements in the innovation being studied, which increase the net attractiveness of the innovation, rather than a result of changes in the receptivity of prospective adoptors. Therefore, he postulated a replacement of "the essentially static concept of a given innovation...by a more realistic recognition of the likelihood of significant improvements over time..." (p.248). The present study suggests that such improvements or modifications can be perceived in a behaviourist's model as part of the suppliers' activities (reactive or proactive) to increase the rate of adoption and diffusion of their innovations, and as such, their influence on the adoption process can be explicitly assessed.

It must be stated here that all the above activities of the suppliers accord with the extant conceptualization of the role of suppliers of innovations i.e. suppliers and marketers of innovations should manipulate their firms' marketing mix in order to adjust their innovations (offers) according to the conditions and needs of the buyers. However, the present study substantiates that suppliers also may play an ***educating role*** in the innovation process. By doing so, they assist potential adoptors to improve and adjust their own conditions and to realize opportunities which create a more favourable perception of the innovation by them thus, leading to a positive adoption response.

A clear implication for the theory of adoption of technological innovations is that it should re-assess the spectrum of 'technologies' a firm possesses and which can be used for enhancing the adoption prospects of its new products in the market place. Currently, these 'technologies' include the technological (R&D) and commercial (marketing) competencies of the firm but they are 'narrowly' defined since they are conceptualized only within the frame of the new product activities of the firm. The author deems that the latter is a direct result of marketing's over-emphasis to the needs of the customers and the product. Indeed, the official AMA definition of marketing is: "marketing is the process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational objectives (AMA Board, 1985). In other words, marketing determines the benefits which will satisfy the consumer in a given situation and offers the product which provides those benefits (Kotler 1988, Murphy and Enis 1986). However, one should acknowledge that the benefits for the industrial customer accrue not from the product as such but from the 'use' of the product in 'appropriate' situations. The latter broadens the scope of the exchange between the supplier and the customer and as such of marketing.

Bagozzi (1978) and Kotler (1972) suggested that marketing is an exchange. But the exchange between supplier and customer involves something more than the simple 'exchange' of products (for payment) which result in mutual satisfaction of the differing objectives of the seller and buyer. That is, marketing's role also is one of assisting the realization of benefits by the customer. In other words, marketing also has a role to play in the implementation of the technological innovation both internally (i.e. within the firm of the potential adoptor) and externally (i.e. within appropriate situations). Whilst the significance of the former for the adoption and diffusion of technological innovations has already been acknowledged by researchers (e.g. Van de Ven 1986, Leonard-Barton 1988) the latter is still largely unexplored. Despite this lack of research, recently Dunn et al. (1991) postulated that todays buyers do not respond only in terms of what existing tasks can be done better with technology, but rather what they can do because they have the technology. The findings of the present study suggest that research efforts in this direction will benefit by incorporating in the marketing's 'tool-kit' (i.e. product, price, promotion and distribution) the broader skills, experience and competencies of the firm.

The foregoing substantiate once more the very important role of suppliers in the adoption process of an innovation. Consequently, the established view that supplier considerations enter the adoption process only at its final stages (i.e. at the stage of supplier choice and after the decision to adopt an innovation has been taken) is debatable.

In addition to the influence upon adoption response of supply side factors, the present study confirmed the influence upon adoption of factors exogenous (see Ch.7, sect.7.4), as well as, endogenous to the firm (see Ch.7, sect. 7.5, 7.6).

Regarding firms' endogenous factors, this study attributed part of the innovative adoption behaviour of firms to their asymmetries and diversities with regard to their technological and behavioural dimensions of their innovativeness. To this end the present study offers a new conceptualization of the innovativeness of organizations which may be found useful by researchers in this field. Also, the way in which the latter dimensions were manifested in the present study may assist researchers attempting to quantify these dimensions. Nevertheless, the author acknowledges here that, owing to the objectives of the study and the nature of the technological innovations involved, the indicators of the technological dimension of the innovativeness of organizations were restricted to the production area and the products of the firm. The author's conjecture is that organizational innovativeness cuts across the total organization and therefore its technological dimension, as well as its behavioural, should involve measures (indicators) from production, marketing, R&D and management systems.

Moreover, the fact that in the present study the innovativeness of organizations was taken into account as a factor mediating the adoption response of a firm towards an innovation and not as the sole determinant of it, may be found useful for overcoming some of the critique which has been raised against the concept of innovativeness (See Ch.1).

Besides, by considering factors exogenous and endogenous to the firm, the study reported here has managed to reveal stimuli, needs, capabilities and attitudes of the firm towards an innovation and to identify how these issues have conditioned the adoption response of the firm.

Nevertheless, this study indicated that stimuli, capabilities and attitudes towards innovation, although necessary, are not sufficient factors for discriminating adoptors from non-adoptors of specific innovations.

Another necessary factor is the perceived 'fit' of the innovation with the needs, capabilities and objectives of the firm. On the basis of insights offered by this study, this 'fit' is the outcome of the juxtaposition of the decision maker's notional understanding of the firm's needs, capabilities, objectives as well as, expected advantages from the adoption of the innovation, with his notional understanding of what is promised by the supplier and/or what is communicated to him or through own efforts to learn more about the supplier and the innovation from sources other than the supplier itself (See Ch.7, sec.7.1 & 7.7). The latter re-inforces the significance of the perceptions of potential adoptors in their decision to adopt or not a technological innovation. In addition, it extends the cognitive argument in the formation of these perception in that it acknowledges the role of the information provided by the supplier and other sources. Moreover, it suggests that this 'fit' is the outcome of a process of 'juxtaposition' of different elements and as such it provides useful directions towards a better understanding of the well emphasized process by which perceptions are formed and indeed change.

Overall, the present study has confirmed that the clusters of factors considered here do have an influence (individually and collectively) upon the adoption response of firms towards an innovation. A clear implication of this is that, any attempt towards the construction of a theory explaining differences in the adoption behaviour of firms, has to consider issues from all of the areas investigated in this study. These are a) the activities of the supplier; b) the environment of the prospective buyers; c) the technological and behavioural diversities and varieties among buyers; and d) the perceived 'fit' of the specific innovation, in its complex form, with the needs, capabilities and objectives of the firm.

Having presented the theoretical implications of the present study's results, the next section will attempt to illustrate what practical implications can be derived from this study and how its results can be used by parties interested in technological innovations.

8.4. PRACTICAL IMPLICATIONS

Recently, Tushman and Nadler (1986) postulated that "in today's business environment, there is no executive task more vital and demanding than that of sustained management of innovation and change...to compete in this ever-changing environment, companies must create new products, services, and processes; to dominate, they must adopt innovation as a way of corporate life" (p.74). To this end, this study has produced important practical implications for assisting both suppliers and potential adoptors of technological innovations, as well as policy makers in their attempts to enhance the development and adoption/diffusion of technological innovations. The present section will report these implication which however, must be perceived in light of the limitations of this study which are acknowledged in the next section (8.5).

8.4.1. IMPLICATIONS FOR SUPPLIERS OF INNOVATIONS

A major concern of firms engaged in the development and selling of innovative products is how to find and produce products which will not only be technically successful, but also commercially successful. To this end the present study has provided useful insights. Primary among these, is the fact that this study identified salient differences among adopter firms and firms that rejected the technological innovations under consideration. Successively, these differences formed the basis upon which a profile of adoptors was built. This is of extreme importance to innovation producers, since it can be used by them as an identification guide to assist: a) their attempts to seek their collaboration during the innovation's development process thus, safeguarding, among other things, the compatibility of the innovation's characteristics with the users' needs and operational conditions (Hippel 1976); and b) the early targeting of these firms thus, achieving an early adoption of their innovation which will give rise to the diffusion process (Baker 1975a).

Moreover, the greater understanding of the suppliers' role in the entire innovation process, which has been gained in the present study, reveals the whole spectrum of opportunities for the undertaking of activities which may influence in a positive way the adoption response of firms towards their innovations. Some of these opportunities re-inforce the current suggestions of marketing theory and prescription whereas others highlight salient, though very important, aspects of the suppliers' role in the entire innovation process.

These opportunities are presented in the following paragraphs in the form of a set of 'guidelines' for suppliers.

A). Suppliers should manipulate their firms' marketing mix variables (including product development) in order to adjust their innovations (offers) according to the conditions and needs of the buyers. This is in accordance with the extant conceptualization of the role of suppliers and also has been substantiated in the present study.

B). Suppliers should realize that they can adjust their innovation (offer) continuously i.e. R&D and marketing activities can be used throughout the innovation process, and not only at the development or commercialization (adoption) phase respectively. An immediate benefit of the latter, is a more balanced allocation of attention and resources in R&D and Marketing activities throughout the entire innovations process.

Recently, Oakey (1991) remarked that suppliers are facing considerable financial problems at the initial stages of their products' life cycle. This is owing to the fact that the introduction of the new product in the market demands many resources which however, the firm does not possess since most of them have been already used during the development phase of the new product. To this end, the suggested above balanced allocation of resources may well be used for overcoming the latter problem.

In addition, producers/suppliers of technological innovations should realize that the 'social dimensions' of the development process, which have been postulated in this study, are capable, if managed effectively, of creating 'resources' which can be used towards the marketing of the product thus, reducing the amount of resources which are needed after the product has been developed. In other words, suppliers should pay attention to the management of the relationships with third parties in the development process. The effective management of these relationships may have synergistic effects since, it contributes not only to the successful technical development of the product but also to its eventual acceptance in the market place.

C). Suppliers can play an 'educational' or 'change agent' role, by studying the characteristics of the adopting firms. That is, they can assist prospective adoptors to upgrade their innovating capabilities and behaviour thus, creating more receptive customers not only for their present new products, but also for any future innovations developed in the market. To do so, suppliers should re-examine their firms' 'technologies' and identify which of them can be used for enhancing the adoption prospects of their innovations in the market place.

The findings of the present study offer a promising basis for the latter search and re-examination.

D). Finally, suppliers can improve their own role in the industrial adoption of innovations by realizing that supplier-related intangible characteristics of the innovations should be understood too and modified accordingly. More specifically, they should realize that the conduct of their corporate business has a direct effect on the market prospects of their innovations. An immediate result of the latter, is that the role of marketing is not only one of assisting the development process and performing the commercialization process of innovations, but also one of aligning the corporate management with the management of innovation. This means that there is also a proactive role for marketing to anticipate and prevent corporate activities which might harm in the long run the innovations produced by that firm, and as such it should be approached and implemented by the firm.

Furthermore, this study has revealed specific areas on which a prospective producer of innovations should pay attention. These areas cover the whole spectrum of the continuous innovation process, and are as follows:-

1. Regarding idea generation.

A review or the new product development literature shows that, in the past have been identified many methods for idea generation (Wind 1982, Sowrey 1990). However the use of most of these methods require a certain degree of knowledge or experience by the intent user and/or the existence of sufficient financial resources. The present study substantiated that the commercial activities of the firm and the after sales service it provides can be used as mechanisms for identifying real market needs and thus for bringing ideas for new product development. The latter is extremely important especially for small firms which do not possess the necessary skills or resources to pursue market research.

2. Regarding evaluation.

This study revealed that one important implication for producers of innovations is the fact that when evaluating the development of an innovation they should determine its compatibility with the strategic objectives of the firm, as well as with its technical and commercial capabilities.

This study also highlighted that the existence of a customer to adopt the, not yet developed innovation, as well as the existence of a strong product champion in the firm who approaches innovations as a challenge, might lead to the overlooking of important strategic, commercial and technical issues. An implication for producers is that a more formal evaluation approach of innovations will guarantee that, sufficient attention is being paid to these issues. This may be achieved by the use of a product innovation charter, as the one suggested by Crawford (1980).

3. Regarding research and development

The experience of the producers of innovations in this study indicates that a firm operating under similar conditions might face both technical and financial problems during the development phase of their innovations.

An implication for producers is that, they should consider strategically these issues before any attempt to develop an innovation. To this end, areas of unknown technology must be recognised at the beginning of the development process and attempts should be made towards its acquisition. This may take place by collaborating with other firms which possess this technology or know-how. Also, in view of possible financial problems during the development of an innovation, producers should consider both the participation of a customer in the process, who will undertake part of the research and development costs, and the utilization of governmental incentives. This in turn, is expected also to assist the testing of the prototype innovation which has been found in this study as a very important, although very resources demanding stage of the innovation process (see sect.7.2).

4. Regarding introduction & commercialization

The findings of this study suggest that the adoption response of firms is influenced not only by their perceptions about the product itself, but also by their perceptions about the supplier. However, as it was found, the same properties of the suppliers and the innovations were perceived differently by the adoptors and non-adoptors (sect.7.1). This was attributed to the fact that prospective adoptors approach innovations within the realms of their own and particular needs, capabilities, objectives and expected advantages. It is believed that, suppliers will benefit, both in their development and marketing activities, by studying the above conditions proactively. Such an approach would have assisted suppliers in this study to realize that by comparing the price of an innovation with competitive innovations of other European firms (case of power supply system), might be irrelevant for a prospective adoptor who considers also competitive products from Taiwan which certainly are cheaper. By the same token, promoting the flexibility of a packaging machine in accepting new types of packaging material, does not create any incentive to a firm that has not yet realized the importance of new packaging.

Clearly, the above issues suggest, once more, that a supplier should try to identify segments among its potential customers and hence, build marketing campaigns focused to each segment. To this end, the profile of adoptors produced by this study can be used as a segmentation parameter. By the same token, further segmentation may be achieved by means of other variables which have been identified in this study distinguishing adoptors from non-adoptors.

8.4.2. IMPLICATIONS FOR POTENTIAL ADOPTORS

One implication of this study for firms adopting innovations, is the realization of the fact that, managerial decisions taken in the past have a direct influence upon the opportunities, capabilities and constraints towards technological innovations that these firms will face in the future. Results of this study indicate that these decisions are associated with issues from both the external and internal environments of firms. More specifically, a firm that wishes to increase its capabilities and receptivity towards innovations should pay attention to the following issues:

1. The firm should attempt to avoid markets with intense competition in price; intense competition in price may deplete the firm from resources necessary for the adoption of innovations (see sect.7.4).

2. The firm should be alert to identify or even to anticipate changes in the competitive environment, since they provide a strong incentive for adoption of innovations (see sect.7.4).

3. The firm should attract customers with a favourable attitude towards the use of new technologies by the firm and a demand for the introduction of new products; this will give it a stronger incentive to adopt innovations and will also facilitate adoption (see sect.7.4).

4. The firm should maintain frequent communication with similar firms in the industry and with its customers; this will enhance awareness of innovations, especially for small firms which lack resources to find innovation through their own research (see sect.7.4).

5. The firm must take measures to avoid depending upon few customers or upon few products. Moreover, its product policy should provide for the continuous introduction of new products. Existence of few customers or products make adoption a more risky attempt in view of possible delays in the production process (see sect.7.5)

6. The firm should recognize a proactive role to its recruitment policy rather than a reactive one; this will guarantee the existence of professionally competent people in the firm, which will increase awareness and familiarity with innovations (see sect.7.6).

7. The firm should encourage its employees to participate in international scientific conferences, as well as their travelling abroad; this is expected to create positive attitudes towards change and to increase the awareness of innovations produced abroad (see sect.7.6)

8. The firm should maintain a 'reasonable' level of organizational formality; this is expected to assist the smooth running of business thus, allowing time to managerial staff for activities such as contacting their customers, suppliers and visiting domestic and international technology exhibitions (see sect.7.6).

Moreover, results of this study show that when information on specific issues provided by the supplier, are perceived as sufficient by the buyer, the risk which is inherent in the adoption of an innovation is reduced (see sect.7.3). Given the fact that the innovation adoption process has been found as a 'heuristic interplay' among suppliers and buyers, prospective buyers should not wait to receive sufficient information from the supplier. Instead they should demand for more information regarding his R&D expenses spent for the innovation's development, his after sales service, and his credibility.

Marketing scholars have postulated that buying is marketing too (Kotler & Levy 1973). As such, and on the basis of the findings of this study, it is believed justifiable to suggest that prospective adoptors should approach the adoption of innovations within the realms of marketing. Furthermore, such an approach will reveal to prospective buyers that they can pursue the adoption of an innovation not only by adjusting their own conditions so as to be more compatible with the innovation. Instead, they can also attempt to modify the innovation as such, or the offer of the supplier in order to make the innovation compatible to their own condition.

Kotler and Levy (1973) have suggested the marketing strategies of coercion, inducement, persuasion and education for a buyer who wants to acquire a product from a reluctant seller and/or from a limited-supply or preferred-clientele seller. However, the same strategies, alone or combined, can be used from a prospective adopter in order to increase what has been referred to in this study as 'fit' among the adopting firm, the innovation and the supplier. Indeed the intent adoptor can participate in the actual development process of the innovation by offering financial assistance (an inducement strategy). This will allow him eventually, to dictate changes in the product, either by power (a coersion strategy) or by providing information to the supplier regarding his operation (an education strategy). By the same token, an intent buyer can persuade the supplier to alter his offering (i.e. price, technical modifications, accompanied services) by undertaking any prototype testing of the product, or by assisting to any promotional activities of the product (a combination of inducement and persuasion strategies).

8.4.3. *IMPLICATIONS FOR POLICY MAKERS*

The role of the government policy in assisting the development, adoption and diffusion of technological innovations has been postulated by many influential writers such as Abernathy and Chakravarthy (1979), Pavitt and Walker (1976), Rubenstein et al. (1977).

In addition, Rogers (1983) maintains that the government policy makers' attempts to formulate, implement and evaluate their pertinent developmental and investment programmes can be assisted by the findings of innovation studies. This study offers the following insights for policy making in the field of development and adoption of technological innovations.

To begin with, policy makers, when deciding where to allocate funds, must take into account not only the technical proficiency of the candidate firms, but also their ability to cope with the requirements of the whole range of the continuous development-adoption and diffusion process. As results indicate, producers in this study were capable of identifying real market needs mainly due to their previous commercial experience and the technical competence they had acquired by means of the after sales services they were offering. An obvious implication is that, policy makers should consider favourably applications from firms with substantial commercial experience that decide to move into the manufacturing field alone or in co-operation with firms already in this field. Clearly, this can not guarantee the development of technological innovations. However, it can enhance the chances for improvements or modifications of existing products and the existence of real competitive advantages from an application point of view. The former can be reasonably expected in the long run, to provide the necessary technical and marketing experience for the identification, development and marketing of technological innovations.

Moreover, the findings of this study can be used for a more balanced allocation of governmental funds. To this end, resources should be directed also towards assisting producers to overcome any financial difficulties accrued from the long period of new product testing as well as, from the development period of the innovation. Again, they should provide for the high cost for participating in international trade shows and exhibitions (see sect.7.2).

In addition, this study has revealed that infrastructural conditions can also affect the development and adoption of industrial innovations. These conditions were related to the lack of specialized components in the domestic market of Greece and the lack of research institutes as well as technical journals (see sect.7.2). Governmental policies may assist the foundation of research institutions which may be capable of importing components otherwise inaccessible to small firms. By the same token, they can provide incentives for the publication of technical journals.

Regarding firms that adopt innovations, this study indicates that government policy makers should take steps towards the following issues:

1. To enhance competition in product features and services in the industry, e.g. by providing financial incentive for the development of new products in the short run, and by raising customers' demands through educating programmes in the long run.

2. To weaken the barriers for new firms entry in the industry e.g. by helping new entrepreneurs to find the necessary initial capital for the start-up of their business.

3. To promote the participation of people in international conferences, e.g. by undertaking part of the relevant costs or by providing tax reliefs.

4. To promote the communication of firms with research institutions and universities, e.g. by organizing seminars or conferences and by financially assisting the collaboration of universities with industrial firms.

Furthermore, it was found that Greek firms have an inherent fear of technological products produced in Greece (see sect.7.1). This indicates clearly the poor technological image of the Greek industry even to its own participants. Given the former, it is difficult to suggest here whether policy makers should undertake promotional activities towards enhancing the technological image of the country's industry as a whole, or merely to accept the existence of 'good' and 'bad' firms and thus to differentiate and concentrate their promotional activities. The present study indicated that two of the producing firms hide their Greek origin when exporting their products; which, obviously, does not help the image of the Greek industry at all. Nevertheless, one can reasonably expect to be easier to promote the image of individual companies rather than the image of an industry as a whole.

However, this study has also indicated that adoptors of innovations were perceiving the governmental attitude towards innovation as being more favourable than the non-adoptors did (see sect.7.3). This clearly implies the need for promotional activities towards enhancing better perceptions among firms regarding the government's attitude to innovations. Moreover, given the risks involved in the adoption of innovations and the dynamic nature of technological developments, results indicate that a reduction of interest rates and the bureaucratic procedures within banks or governmental financial institutes will assist the use of governmental incentives by firms considering the adoption of innovations.

8.5. LIMITATIONS OF THE STUDY

This study, like many others, has its limitations. Primary among these, is the fact that it was restricted to only a small number of firms and industries in one country and as such, the application of its results to other industries or countries cannot be claimed before any replication of its findings is made in other countries and industries.

Furthermore, the need to study in detail the development process of each innovation, as well as the practical difficulties in identifying innovations in Greece has limited the number of producers/ suppliers. Therefore, with regard to their industry specific factors, comparisons among them were difficult to be made.

Another limitation is that the technological innovations considered in this study were within the context of the production area and the products of the firm. Therefore, its findings must be considered cautiously in the case of technological innovations within the context of other areas of the firm.

In addition, in this study producers were identical to the suppliers of the innovations in question. However, past research has indicated many instances were these two roles are performed by different parties. Clearly, consideration of the latter in future studies might reveal additional factors that influence the adoption response of firms towards innovations.

Moreover, this study has concentrated only upon the adoption or rejection response of individual firms at a point in time rather than over time during the diffusion process of an innovation. Therefore, our knowledge about the adoption response of firms towards technological innovations may be further enchanced by studying the diffusion of an innovation alongside its development and adoption. Specifically, we may learn more about why some firms adopt and use a technological innovation, while others either reject it or wait and adopt it at a later stage.

Finally, the study has focused on the adoption behaviour of small-sized firms rather than large-sized firms. This was made in order to fill a recognized gap in the literature of the adoption of innovation. Undoubtedly, studying both small and large-sized firms simultaneously will enable not only the investigation of any similarities or differences between the two, but also the applicability of the present results in cases where a more complex decision making unit is involved.

In view of the above limitations and the present study's results the following recommendations for further research can be made.

8.6. RECOMMENDATIONS FOR FURTHER RESEARCH

Taking into account the results of this study, as well as its limitations, the author recommends that a larger scale study is required. To this end, from a methodological point of view, it is essential to have a larger number of producer firms and adopters or non-adopters than the present study did. This eventually, will enable not only comparisons among producers/supplier, but also the investigation of the influence of supply side factors upon the diffusion of innovations.

Moreover, a research design which would take into account innovations and/or producers/suppliers competing with each other, will substantiate the benefits to be gained by the study of supply side factors. This can be done by considering innovative product classes rather than specific innovations as the ones addressed in the present study. Such a design also will enable the investigation of structural characteristics of the industry of suppliers and their influence upon the adoption response of firms and the eventual market performance of the innovation.

In addition, if such a study is conducted not only in one country but in many, e.g. among many EEC countries, it will enable the identification of international similarities and differences in the process of innovation, which from a policy point of view are essential for a common European policy to enhance the creation and successful adoption and diffusion of technological innovations. Furthermore this will enable taking into account as well as assessing the influence of cultural parameters in the adoption response of firms towards technological innovations.

Finally, the author deems that more research is needed on the *'ontology'* of products. That is, research towards answering the question, What is the buyer really buying? Attempts to answer the latter question may shed additional light to the way buyers' perceptions of a product are formed and change; a fact which is of extreme importance for the study of the development, adoption and diffusion of innovation. These attempts may start with an integration of theoretical and empirical findings advanced in the areas of adoption and diffusion of innovations (more specifically attributes of innovations) and organizational buying behaviour (more specifically the set of buying criteria). Subsequent attempts may find it useful to explore the notion that products are not simply bundles of attributes, features or benefits but rather part of the means that mediate the realization of benefits. In other words, research on the 'ontology' of products should approach the issue within the context of "the way a purchaser of a product performs the total task of whatever it is that he or she is trying to accomplish when using the product" (Kotler 1988, p.447).

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APPENDIX A

CASE STUDIES OF THE PRODUCERS' FIRMS

CASE STUDY ONE

CNC BENDING MACHINE

1.1. THE DEVELOPMENT OF THE INNOVATION

1.1.1. THE FIRM

The firm in question was established in 1984 for the design, manufacturing and commercialisation of machinery used in the construction industry. It is privately owned by two persons who are father and son. The father and founder of the firm is currently the general manager (GM) of it while the son who is a mechanical engineer is in charge of the technical/ design department. The firm has also a production and a marketing department.

Interviewing the GM it was found that his risky and innovative character alongside his prior knowledge and connections in different industrial sectors in Greece were the main reasons for his attempt to create the company. Another reason mentioned by him was the knowledge in engineering of his son which enabled him to bring into reality his innovative ideas and solutions to problems he identified in the construction industry. His previous attempts in business were related to the establishment of small non-manufacturing firms and their selling after the establishment of a good reputation that made these firms attractive to buyers. In one case he managed to earn large sum of money by licensing to others the "name" of a firm he had created and which was famous in Greece for the quality of its services. These attempts had made him a respectable member of the business community in Greece although from what is known to the author, some members of the business community despite their admiration to his achievements used to call him an "opportunist" rather than a businessman in their own context. However being well known he managed to create the important links in the industrial sectors which allowed him to gain useful insights into the problems of many firms which in turn were translated to opportunities by him.

The firm in question is his first attempt to the industrial manufacturing sector in Greece and although it started in the construction industry, very soon (1986), it entered the wire and mattress industry, producing CNC programmable wire bending machines.

From the end 1986 the firm started to achieve remarkable growth rates in sales which are also depicted in the number of employees: almost 10 in 1984 to 120 in 1989. Out of the total number of employees 40 are mechanical or electrical engineers with a university degree of which 15 are involved in research for new products, 70 are skilled workers in the production and 10 are employed in the offices of the firm (5 in the marketing department).

The marketing director (MD), who was among the 10 persons in 1984, explained that the high technology used in the firm's products contributed to its export orientation. Today (1989) it exports 95% of its total production in approximately 25 advanced economies including USA, Japan, W.Germany, Great Britain, France etc. In 1986 the exports sales volume of the firm amounted to 260 million drachmas (almost 1 million pound) while for the 1989 orders have exceeded the amount of 1 billion drachmas (almost 3.5 million pounds)

The MD stated that the benchmark point for the company's growth is regarded to be the year 1987 when the innovation in question was produced and licensed to a leading European company manufacturing machinery and equipment for the mattress industry.

Furthermore, he explained that the success of the company is based on the effective combination of hydraulic systems with computerized controls. He claimed that the firm's patented inventions for the hydraulic systems brought the firm into the forefront of the technology world-wide. Today the firm is the owner of more than 20 patents in Greece while 3 of them have been approved by the European and American Patent Bureau. In addition the firm has produced a whole range of CNC bending machines for the construction industry and currently (1989) is developing Laser wire cutting machinery and machinery for the road construction industry with integrated robotic systems. The latest achievement of the firm is the development of a tele-information, tele-quide system (PAN-DRIVE) for the car industry which according to the marketing director of the firm is much simpler and more efficient than the ones developed by the few companies experimenting on the same issue world-wide.

To illustrate the culture of the firm here is a sample of communication messages as they are presented on leaflets and brochures advertising its products:

"WHEN TECHNOLOGY CHALLENGES ART"
"HI-TEC...LO-SKILL"
"WIRE BENDING EXPERTISE...MIND BENDING EASY"
"HIGH INCREASED PRODUCTIVITY"
"MASSIVE SPACE AND SKILLED LABOUR SAVINGS"
"CONSIDERABLY REDUCED PRODUCT COST"
"UNLIMITED PRODUCTION FLEXIBILITY"
"IMPROVED RESPONSE TO THE CUSTOMER NEEDS"
"ABILITY TO PRODUCE SAMPLES WITHOUT TOOLING"
"WASTE OF MATERIAL ELIMINATED"

1.1.2. THE INNOVATION

The innovative product in question belongs to the product range of the CNC programmable wire bending machines for the mattress industry. It is used for the production of wire frames for innerspring mattresses. There are two versions of this machine, one for round steel wire and one for flat steel wire. A brochure of this product containing its technical specifications is provided at the end of this appendix.

According to engineers from the Hellenic Organization of Medium and Small Firms and Handicraft the product in question is an innovative one since it revolutionize worldwide the process for making the wire frames used in the mattress industry. More specifically, this process was previously performed manually by one or two unskilled workers who, on a large sized table and with the help of a pneumatic gun, had to perform the following sequence of activities: a) pull the wire, b) straighten it, c) measure it and d) bend it. Since each frame is an orthogonal parallelogram (four sided), it has 4 angles and therefore, the previously mentioned sequence of activities had to be performed 4 times too; the fourth bending was followed by a cutting of the wire so as to enable the process to start all over again for the next frame. It must be mentioned here that each mattress is consisting of two frames. The introduction of the innovation in question has automated and simplified the whole process which is now performed by the machine itself. To this end the wire is conveyed to the machine which after being set-up by means of the attached computer (size of frame and number of frames to be produced) bends, cuts and stores the wire-frames without any supervision.

1.1.3. INCENTIVES FOR THE DEVELOPMENT OF THE INNOVATION

As it was mentioned by the MD the firm as early as 1986 had already produced under custom-made agreements its first wire bending machine for wire used in the construction industry. This machine was also an innovative one and although they had realized the prospects of it, its sales growth potentials were limited mainly due to the lack of the necessary resources and space. The factory of the firm was very small and totally inappropriate for the comfort needed for the design, development and testing of new technology. In addition firm's offices were also small, without the communication devices and the image of a firm in a high technology industry. As it was said by the MD, the lack of funds for their selling activities and for the further development of the existing and new products made them keen to consider every possible customer's order that would provide them with the necessary developmental resources and leave a profit to be used for the selling costs of the other products.

In 1986 took place their first attempt to present their machinery in an exhibition (INDEX) held in Greece. Their small stand at this exhibition was approached by a visitor who claimed to be a Greek manufacturer in the mattress industry. After he had examined their products, he asked whether these machines could be used also for the production of frames for innerspring mattresses from round steel wire. Due to the challenging nature of the firm's owner who was present they immediately responded to this request and arranged a meeting with the prospective customer to explore the details of any potential collaboration. Indeed the meeting took place some days after and during that questions were raised about the appropriability of the existing machinery for the new application. The shape of the new wire to be processed was different (round steel), the size, the wire strength, the bending speed and the cutting accuracy needed were also different. But, as the MD said, "at the end it was not but wire, a material we already knew very well how to handle". He said that they were confident that they could manage it. Of course the relevant expenses were high but the opportunity was there. Being sure that the customer had realised the difficulties of a new design and development they asked him whether he was willing to finance the design and development of the new machinery. Within a matter of few days they had a proforma calculation of the relevant costs (mostly intuitively) and they offered to the customer a price for the development and the final purchase of the machine which was estimated to be produced in the following 6 months.

It was August 1986 when the agreement took place. The subject was known, the challenge and the self-confidence were high too, the developmental funds existed, a deposit in advance of the purchasing was expected and the customer willing to help with the provision of ideas and insights into the nature of his works. The result of this agreement was the CNC bending machine for round wire frames while the next year (1987) a similar agreement with another customer resulted to another version of the machine for the bending of flat wire frames.

1.1.4. DEVELOPMENT ENABLING CONDITIONS

The first and most important enabling factor cited by the MD was the skills of the two owners of the firm. Father and son, general manager and technical manager respectively, are persons with unlimited technical skills and they are the prime sources of the firm's inventions and patents. The general manager identifies the opportunities, finds how to solve problems in ways that only few persons have thought and along with his son's modern technical knowledge in mechanical engineering brings into reality any idea. The second important factor was the small size of the firm which had provided the flexibility for quick decisions and full commitment to the development of the idea. Indeed as the MD cited "the leading European manufacturing firm in the same field needs 4 years to develop new machinery while we need only 4 to 8 months. A third one was the availability of the necessary funds which have been raised from the customer. The MD said that "without those funds we would never dare to try developing this machine" A fourth factor, was the fact that the function of the new machine was similar to that of their existing products, thus they had the needed knowledge and experience.

Finally the MD mentioned the help which was offered by the customer, informing, describing and even teaching them the kind of his production process thus providing the necessary information for the technical specifications of the new machinery.

1.1.5. STAGES OF DEVELOPMENT/ PARTICIPATING PERSONS & SOURCES OF INFORMATION USED

The final decision to develop the innovation was taken very quickly and the relevant assessment of its characteristics as well as the financial and commercial evaluation was made by a very small number of persons. The role of the GM of the firm was vital through all the stages which are difficult to be separated and clearly identified. Trying to find out on which stages specific importance has been allocated was found that:

The whole process had begun with meetings between the customer and the GM and few technicians of the firm. During those meetings the customer explained his work and assisted to the identification of the specification of the machine regarding the expected output and its quality rather than the technical properties of the machine.

Almost simultaneously the GM of the firm began to evaluate whether those specifications were within the capabilities of the firm and to prepare an estimation and comparison between the developmental costs and the final price to be charged to the customer. Within few days the final proposal regarding developmental costs, final price and delivery dates, was ready. The acceptance of these conditions from the customer initiated the development of the innovation.

The commercial evaluation and the assessment of the marketing alternatives for the product did not take place that time. The GM said that the customer was existed and they did not know yet whether their product was going to be purchased by other customers. They did not even know the mattress industry since it was their first attempt into this market. The GM added that today the whole process is much more formal and special attention is being given to the financial evaluation as well as to the commercial so as the market potential to be assessed in advance of the development. However, inspite the formality the number of persons participating in the evaluation process is very small and thus even now the decision to develop or not a new product is taken very quickly.

A large number of information sources were presented to the MD in order to find which of them were used during the stages of the innovation's development. The following table 1.1 illustrates these source alongside their importance per stage as stated by the MD. Where 1: the most important, 2: the second important source, and so on.

Table 1.1: Information sources used at different stages of development.

Stages	Idea Initiation	Attributes Assessment	Technical Evaluation	Financial Evaluation	Commercial Evaluation
Prior experience		1	1	1	1
Formal contacts in firm		2	4	2	3
Personal formal contacts with members of other firms		3	2		
Contact with customers	1	4			
Contacts with potential users					2
Technical journals		5	3		

1.1.6. FACTORS LED TO THE ASSESSMENT OF THE FINAL CHARACTERISTICS

The factors that influenced the assessment of the final characteristics of the innovation alongside their extent of influence as cited by the GM are illustrated in the following table 1.2.

The GM indicated that the assessment of the final characteristics of the innovation was based upon the firm's technical capabilities (know-how) and its machinery and equipment. However as the GM added, although the above factors have played initially an important role the firm was latter forced to collaborate with other firms for the development of some electronic parts for the innovation.

Table 1.2.:Factors influencing the innovation's characteristics

Factors	Influence
Users' perceptions	4
Firm's technical capabilities	6
Firm's machinery & equipment	5
Market research	1
Financial evaluation	4

Scale: 1 to 7 were 1:not at all, 7:to a great extent

Point 4 was ticked for the financial evaluation and for the users' perceptions. User' perceptions in this case was regarded the involvement of the customer who initiated the idea. The GM stated that the customer did not provide design specifications rather he described his work and the results he was expecting from the use of this machine regarding output and quality. However the GM added that of great importance to the development of the innovation were the pressuring requests of the customer for quick design and development. Regarding the financial evaluation it was more a comparison of the estimated developmental costs and the final price they could charge to the buyer rather than a formal evaluation based on financial tools.

Since the firm had not conducted any market research before the development of the innovation, market research was allocated point 1 in the above scale.

After the development of the innovation no important differences were found between the firm's perceptions of the innovation's characteristics and those of the final users of it. However the GM mentioned that after the first wave of diffusion of the innovation the feed-back from the customers helped the firm to improve the machine by adding features which have not been considered at the beginning.

1.1.7. FINANCIAL & COMMERCIAL EVALUATION-R&D RESOURCES SPENT AND USE OF EXTERNAL HELP

As it was mentioned already, the financial evaluation of the innovation was intuitively assessed. Qualitatively they evaluated the attempt as an opportunity for raising cash to be used also for the other projects within the firm. The GM mentioned that the need for cash was very high at that particular time. The innovation in question absorbed 100% of the R&D resources spent during the period of development.

No commercial qualitative evaluation was performed for the innovation. The reason stated by the MD is that they were producing a product under customer agreement and therefore, the customer for this product was captured in advance and the selling of the machine was pre-secured. In addition for the machine in question the relevant market was totally unfamiliar and at the beginning they even did not know whether they could sell other units of it. The success of the machine was characterized by the MD as accidental and totally unexpected.

To finance the development of the innovation they used two prime sources for raising the relevant expenses. First the payments in advance by the customer and second a grant allocated to them by the Hellenic Organization of Medium and Small Firms and Handicraft. The amount of money they got from this organization was not very large but as it was stated by the MD "it was of vital importance, an effective injection at that time".

1.1.8. FACTORS LED TO THE FINAL DECISION TO DEVELOP THE INNOVATION

Thirteen factors were presented to the MD in order to find which and to what extent each of them had influenced the final decision to develop the innovation. A scale from 1 to 7 was used to assess the extent of influence for each factor, where 1: not at all and 7:to a great extent.

Table 1.3 illustrates the degree of influence of each factor as it was marked by the MD. As it can be seen from this table 5 factors have been mentioned as of great influence to the final decision to develop the innovation i.e. the compatibility of the machine with the production capabilities of the firm, the compatibility of the machine with the technical knowledge of the firm, the low failure risk of such an attempt, the expected profit per unit and that this attempt was a challenge for the firm's GM.

The payback period of that product as well as the ease of patentability have not influenced to a great extent the decision to develop the innovation.

It is interesting that factors such as the competitive activities, the market response, the large number of potential adoptors, the return on investment, the firm's image and the general trends in the industry of the producer have influenced the decision to develop the innovation only to a small degree or not at all. As it was mentioned by the MD these factors were either difficult to be assessed (market response, number of adoptors) or totally unknown due to the unfamiliarity of the firm with the specific industry (industry trends, competitive activities).

However both the GM and the MD stated that "today, although the above factors are taken more into account, still when we decide for the development of a new product the major factors that influence our decision are related to our technological and production capabilities. In addition today we take into account to a great extent the market response and the number of potential adoptors. Our research staff is so heavily involved with expensive research that we cannot afford to develop machinery which is going to satisfy the needs of only a small number of adoptors".

Table 1.3.: Factors influencing the final decision to develop the innovation and to be licensed

	Factors	Influence
1	R.O.I.	1
2	Payback period	4
3	Profit per unit	6
4	Compatibility with our production capabilities	7
5	Compatibility with our technical knowledge	7
6	Competitive activities	1
7	Good market response	2
8	Large number of potential adopters	2
9	Low failure risk	7
10	Vital for firm's image	1
11	It was a technical challenge to the GM	5
12	General trends in industry	1
13	Ease of patentability	3

Scale 1 to 7 where 1:not at all, 7:to a great extent

1.1.9. PROBLEMS DURING THE DEVELOPMENT PROCESS

The MD claimed that no problems have been faced by the firm during the development process.

However interviewing the customer who initiated and financed the development it was found that many problems have occurred regarding the agreement on the delivery dates and the sum agreed to cover the developmental costs. Searching in more depth, it became clear that the firm being unable to cope with some problems during the development sought the help of other firms mainly for developing part of the software and hardware of the computer attached to the machine. To this end many small firms specialised in computers and electronics were contacted. The first collaboration with such a firm did not work well and valuable time was lost. Their second attempt was a successful one. After 3 months delay they managed to produce and deliver the machine to the customer. However the machine presented a lot of problems during operation and for the next 6 months the producer had to make many changes on it in order to make it more sound operationally. These events increased the actual cost of development and arguments appeared between the producer and the customer regarding the issue who was to suffer the additional costs. Due to these arguments the relationship between producer and customer became very bad and in fact it remains bad today.

The above were finally admitted by the MD who stated that: "we know why such problems have been faced by our company. During that time we had no money and time to develop first a prototype of the machine and to test it for a long period in our firm before delivering it to the customer. To this end on purpose we were "using" the Greek market, both for this and other products, as a test market. Our orientation was exports and we did not bother a lot with problems being created in Greece due to this policy. This can justify the problems faced with this customer and in general the relative bad reputation that our company has in Greece.

However now we are in a position to test our products extensively within our firm before delivery and to avoid such mistakes which have caused us a lot of problems in the past".

1.1.10. CHARACTERISTICS OF THE INNOVATION (AS PERCEIVED BY THE PRODUCER)

When the MD of the firm was asked to indicate the degree to which the specific innovation meets a number of criteria (attributes) he immediately made the distinction between the domestic and international market. He explained that the machine per se has some technical attributes that hold the same for both the domestic and international market, but when it comes to attributes that relate to the adoptors' condition then not only the market where they belong but also the conditions of their industry bring some of the innovation's attributes on the surface as either more or less important.

The following table 1.4 illustrates the extent to which the machine meets a number of attributes separately for the domestic and the international market. The scale used is from 1 to 7, where 1:not at all and 7:the machine meets the specific attribute to a great extent.

Table 1.4: Perceived innovation's characteristics

	Characteristics	Domestic Market	International Market
1	Low initial cost	4	7
2	Low maintenance cost	7	7
3	Low pay-off period	4	7
4	High flexibility in use	7	7
5	High reliability in operation	7	7
6	Ease of understanding its use	7	7
7	Labour savings	7	7
8	Product quality improvements	7	4
9	Space savings	4	4
10	It is compatible with existing manufacturing operations	6	6
11	It is compatible with the existing technical experience and expertise	5	5
12	Lowers the unit cost of end product	2	4
13	Permits trial in small scale	-	4
14	Provides better equipment utilization	2	6
15	Introduces savings in production time	7	7
16	Increases variety of end products	7	7
17	It encompasses advanced technology	7	7

Scale 1 to 7 were 1:not at all, 7:to a great extent

As it is obvious from table 1.4 the main differences in attributes between the domestic and international market concern the initial purchasing cost, the pay-off period, the unit cost of the end product and the ability for better equipment utilization. These differences were mainly explained by the MD by the fact that Greek adoptors are very small in size and although a machine is supplied at a lower price in Greece than abroad it is still regarded as expensive.

Due to the small production output of the Greek firms the machine is not fully utilized and sometimes it is used at an extent lower than 1:18 of its production capabilities. This in connection with the cost of the machine does not create substantial savings regarding the cost of the end product. Regarding the utilization of the other equipment of firms it was said by the MD that this machine within the production process of mattresses has much higher capabilities in speed than the springs producing machine which provides the springs to be framed in the wire frame produced by the innovation in question. Thus it is necessary for one firm to have a very fast spring machine in order to use efficiently the bending machine. However the most advanced spring machines supplied in the market are very expensive and Greek firms in contrast with firms abroad cannot afford their acquisition.

1.2. THE MARKETING OF THE INNOVATION

1.2.1. A GENERAL DESCRIPTION OF THE MARKETING EFFORTS

The first adoption of the innovation took place in 1987 and it was the one from the customer who initiated the idea.

After that the firm began to receive inquiries from the Greek market about the innovation. According to the MD this unexpected response provided an incentive to the firm to search the market in more depth trying to realize better what they had produced as well as its commercial prospects. To this end they contacted a number of potential users and they asked their perceptions about the machine. To those who had participated in international exhibition they asked whether they had seen a similar machine abroad. Respondents indicated that the machine is unique and immediately expressed their interest to buy it.

Due to these information the MD stated that the firm started to consider seriously to exhibit the machine at an international trade show. They searched for such trade shows and they were informed that one was going to take place in the same year (1987) at KOELN in W.Germany. It was the INTERZUM 1987 but they had little information about it. The MD said that they did not want to go to an exhibition of mattresses or furniture but rather they wanted one for machinery and equipment for these industries. Since no organization or governmental institution could inform them about the content of the exhibition they again contacted firms in the mattress industry in Greece for information. After they became absolutely sure for the appropriateness of this show they arranged to have a small stand there.

More than 60% of the exhibition's space was occupied by the largest European manufacturing firm of machinery and equipment for the mattress industry. This was a Swiss firm and during the exhibition the managing director of it visited the kiosk of the Greek firm. He remained there for more than 2 hours asking questions about the new machine. Within the same day a "parade of that firm's directors took place in front of the stand", as the MD said. The production manager, the marketing manager and the financial manager of the Swiss firm visited the stand and after a long conversation they arranged a meeting in Greece to discuss the prospects of a licensing agreement regarding the new machine.

As it was mentioned by the MD, when the main competitors of the Swiss firm informed these contacts tried to break off the agreement. They proposed that the firm should not accept to license the machine so as the world-wide monopoly of the Swiss firm to be broken. They also stated that the Swiss firm intended to "bury" the machine and thus the Greek firm will lose a lot of money since it is an innovative product which many companies want to buy.

The above incident did not stop the firm proceeding with the agreement, but as the MD said "it highlighted our source of power in the situation and allowed us to establish severe terms on the agreement and to obtain as much money as possible". Furthermore as the MD explained the decision to licence the innovation was justified by the following reasons: a) the lack of marketing experience by the firm, b) the small production capabilities of the firm, c) the fear for an early imitation of the innovation by large foreign firms and e) by the fact that the orientation of the firm at that time was not on capitalising upon the commercial success of an innovation but instead on raising resources in order to attempt pursuing the many innovative ideas of its general manager. To this end they licensed the machine for a very large sum of money under the accompanying terms that the Swiss company will sell at least 36 items within the next 2 years which will be produced by the Greek firm. Twelve items in the first 6 months, twelve the second 6 months and another twelve items the following year. After the second year the world market was going to belong to the Swiss company regarding that product while the Greek market was decided to remain to the Greek firm. The later was justified by the MD of the firm who said that "the Greek market is our market and our basis and we did not want to create competition to our product in our own market".

1.2.2. FORMALITY OF MARKETING EFFORTS

The MD stated that the marketing procedures they follow are not written anywhere for reference. However their practice which can be regarded as formal due to its continuous use is to find the addresses of the potential customers and to send a direct mail informing them about the existence and the technical specifications of their machines. The efforts continue with the presentation of their machines in domestic and international exhibitions.

1.2.3. INFORMATION MEDIA USED AND PROBLEMS

Thirteen different information media were presented to the MD in order to find which and to what extent each of them has been used by the firm in order to communicate the innovation among the potential adoptors. A scale from 1 to 7 was used to assess the extent of use for each medium, where 1: not at all and 7:to a great extent. Table 1.5 illustrates the extent of use of each medium as it was marked by the MD.

Table 1.5:Information media used

	INFORMATION MEDIA USED	USE
1	Brochures and Leaflets	2
2	Trade shows	6
3	Trade journals	2
4	Technical journals	1
5	Scientific journals	1
6	Personal contacts in professional associations	1
7	Participation in conferences	1
8	Contacts with Universities	1
9	Contacts with governmental institutions	2
10	Informal contacts with customers	1
11	Formal contacts of other firms' managers	1
12	Sales force contacts of potential customers	5
13	Direct mail	7

Scale 1 to 7 were 1:not at all, 7:to a great extent

The MD stated that three main information media have been used by the company: Direct mail, commercial exhibitions and personal contacts of their salesforce with potential adoptors.

In addition the MD explained that direct mail and participation in exhibitions play the role of informing the customers about the product while sales force contacts were mentioned to indicate the final contacts with the potential customer after he had expressed his interest for the machine. This is also justified by the lack of door-to-door salesforce by the company. The MD mentioned that when a customer is invited in the firm he is 60% willing to buy the machine. The role of the salesperson in the discussion with the customer is to evaluate his financial credibility, to solve any misunderstandings and to differentiate the selling conditions in order to match the customers needs and problems. Other information media used to a lesser extent (2) were brochures and leaflets, trade and scientific journals and contacts with governmental organizations. Regarding the direct mail the MD stated that it is performed on a daily basis and they participate in 4-6 international exhibitions and 1-2 domestic per year. The main problem they are still facing with direct mail is the difficulty in finding the addresses of the potential customers either at home or abroad. The MD said that even in Greece where they know the market better than abroad they cannot find firms' addresses easily. For the international market the problem is greater and it is substantiated due to the language problem when technical terms have to be used or terms which define a specific segment of the market. Regarding the international exhibitions they faced problems not only to find them but also to assess their content. Finally regarding the articles in trade and scientific journals it was mentioned by the MD the very small number of them in Greece and their general content. The MD added that "it is very difficult to find a journal specific for our products and even more difficult to ascertain that the one in which you advertise is received by the customers who might be interested to buy".

1.2.4. INFORMATION MESSAGES USED

Regarding the information messages used by the firm the MD was asked to indicate on a scale from 1 to 7, the extent to which these messages included the elements which are illustrated in the following table 1.6.

Table 1.6 : Information messages used

	INFORMATION MESSAGES USED	Content
1	Technical characteristics	6
2	Financial opportunities	6
3	Competitive advantages	1
4	Industry trends	4
5	Company's reputation	4
6	R&D allocation	1
7	After sales service	3

Scale 1 to 7 were 1:not at all, 7:to a great extent

The MD stated that technical characteristics and financial opportunities from the use of the machine were pointed out to quite a great extent when contacting potential customers.

Industry's trends and company's reputation were mentioned to a lower extent (point 4) and after sales service took the point 3 on the same scale. In addition the competitive advantage over other machines and R&D resources spent for that machine were only occasionally used in the information messages.

Regarding the company's reputation the MD stated that it was not used to a great extent in information messages due to the low reputation of the firm in Greece. As it concerns after sales service he mentioned that since at the beginning of their firm's life they had not the means to perform it in the best way they were trying not to advertise and promise extensive after sales services so as the demands of the customer to be minimal.

1.2.5. SEGMENTATION AND RELATED STRATEGIES

At the early stages of the diffusion process of this machine the firm had not conducted any segmentation of the market. The reason stated for this by the MD was that the firm's size was very small and they did not have the resources to attempt or to afford a segmentation strategy. As it was stated, after they realised better what they had produced they started to formulate a clearer concept of their potential market and segmented it geographically. Thus two general segments resulted. The domestic market and the international one. Their target segment became the international. To this end they started to participate in international exhibitions where the MD said they could meet entrepreneurs who could subsequently be their potential customers.

When selling the product they used to take into considerations to a great extent (point 7) the specific conditions of each potential adoptor and to formulate accordingly different selling policies. Formally this differentiation had to do with the price and features of the machine offered to them. Customers who through contacts after the direct mail were perceived as receptive to buy the machine, were invited to visit the firm and see the machine by themselves.

Informally, they differentiated their marketing policy during the personal contacts they had with the customer. A personal evaluation was taken place and depending upon the customer's needs they responded accordingly.

The financial help offered by the firm was the acceptance of 30% of the total price in advance with the agreement, 30% upon delivery and the remaining 40% was due in the following 6-8 months. Sometimes they accepted a beyond recall small deposit from the customer.

Technically they offered the installation of the machine and the training of the worker who was going to use it.

Their after sales service was 1 year. In addition to the above they provided also export services by bringing their customers in contact with foreign firms which would be willing to buy their products or to collaborate in any other way. As it was stated by the MD "we provide our international connections to our customers and we transfer to them our experience in exporting. We know that our product is more appropriate for firms with large production sizes. Educating and helping our customers on exporting we increase their sales and in this way we increase the appropriateness of our machine to their operations.

1.2.6. PERCEPTION OF CUSTOMERS' RISK AND HANDLING METHODS

As it was indicated by the MD on a scale from 1 to 7, the extent to which the perceived risk of the customer was taken into account on selling is point 4, which means moderately. The MD stated that the machine and its output capabilities were so clear that adoptors undertook no major risks. Risk perceptions were identified only regarding the fact that the machine was produced by a Greek company which had not a good reputation.

In order to eliminate as much as possible any kind of customers' perceived risk the MD said that they used mainly 3 methods (Table 1.7).

Table 1.7: Risk handling methods

	RISK HANDLING METHODS	USE
1	Visit operations	6
2	Visit other customers	4
3	Accept penalty contracts	1
4	Provide technical information	3
5	After sales service	4
6	Trial	1

Scale 1 to 7 were 1:not at all, 7:to a great extent

Firstly, and to quite a great extent (point 6) they invited the potential adoptor to visit their factory. They started to use this method extensively after they had moved into their new factory at the beginning of 1987. The work environment in the offices is very luxurious. Computers, fax machines and telex are devices one can see everywhere working without stop while libraries full of books cover the walls. Pictures of their inventions are hanged on the walls and the environment is very clean although their operations in the factory floor are very dirty due to the nature of works. In addition they have different rooms were the various projects of the firm are performed and also a large meeting room in sight well furnitured. Interesting is the fact that the culture developed in the firm is oriented towards an anti-smoking campaign. Only in the very early waiting room smoking is allowed. The MD said that they have many foreign visitors who usually do not smoke and the whole idea seems as a response and a respect to their needs.

To a lesser extent (point 4) they based their risk handling methods on inviting the potential customer to visit firms that already use the machine and now they offer extensive after sales service too. The MD stated that they demand from their most important customers to permit the visit of new customers in their operations for a presentation of the machine in a real work environment. Sometimes they face a lot of problems in achieving that but hopefully they have tight connections with the most important company in the mattress industry in Greece which has already adopted their machinery. This company is nearby to their factory, it is a very open company and thus, they use it as a place to bring their customers.

To a much lesser extent (point 3) they offer extensive technical information about the machine and they are not used to accept penalty contracts for clause provision mainly because as the MD said no customer yet has demanded such a contract.

In addition in special occasions they offer a free trial of the machine for 15 days within the customer's operations. As the MD said they use this method when the customer is very important (large leading firm), when they want to enter a new market or when the selling performance was not very good and the customer remained with doubts about the machine.

Furthermore, the MD stated that they have noticed that most of their potential customers are dubious about the fact that a Greek firm has developed such a technologically advanced product. He stated that according to his opinion this is the most important reason for a company rejecting the adoption of the innovation. To overcome this difficulty the MD said that they do not point out the Greek origin of the machine and they try to create an international rather that a Greek image. To this end the staff of the firm is multilingual, speaking at least 2 languages fluently. In addition the prospectuses they issue are written in foreign languages and even when they participate in international exhibitions they cut from their badges the sign "Greece" or "Made in Greece". The sign "Made in Greece" does not appear anywhere and the MD said that sometimes foreign firms have the impression that the machine is only assembled in Greece due to the low labour cost. He said "we are content with that and we are not doing anything to change it".

1.2.7. AFTER SALES FEED-BACK & ADJUSTMENTS

As the MD stated the follow-up of the performance of the machines produced by the firm is a formal action. This takes place through phone-calls or visits to the customers. The problems that the customer might have faced are discussed and as the MD mentioned this has helped the firm to identify deficiencies of their machines and enabled their further development. For the innovation in question the MD stated that feed-back information and customers' demands enabled the firm to advance the machine even more. He attributed to the feed-back process the latest version of this machine which does not only bend the wire in order to create a frame but at the same time it welds the two non-connected edges of it.

From a marketing point of view the MD said that this feed-back process includes a reappraisal of the points of interest and the doubts raised by each customer during the selling process.

1.2.8. VISITS PER SALE/PERCENTAGE OF SALES AND MARKETING BUDGET SPENT FOR THAT INNOVATION/PERCENTAGE OF ADOPTERS THAT ARE ALREADY CUSTOMERS OF THE FIRM

The MD said that the firm has not door to door salesmen. Usually after the potential customer has expressed his interest for the machine, phone calls, fax, and direct mail is exchanged between him and the firm. At the same time the customer is invited to visit the firm so as to see the machine and discuss with the salespersons. One or two such visits are enough for the selling of the machine. But sometimes due to differences regarding the selling price the customer delays for a long period his decision to purchase the innovation. During the last 3 years only a 10% of the firm's sales turnover has been spent for the marketing of this innovation. To this has contributed the fact that they have licensed the innovation to the Swiss firm which has undertaken all the marketing and selling efforts of it abroad.

The MD mentioned that since the firm had no previous experience in that market the adoptors were not customers of the firm.

1.2.9. MAJOR REASONS FOR ADOPTION OR REJECTION AS PERCEIVED BY THE PRODUCER

The following reasons for adoption have been stated by the MD of the firm: 1. The machine is computer numerically controlled (CNC). This means that only one person within a few minutes can set up the machine which continues to work without any other adjustments. This lowers the labour cost since it releases one worker from the hard and time consuming work of measuring-bending-cutting the wire. 2. The machine has a computer which can be programmed in order to produce frames of different size. This is very important for the Greek mattress industry since a large number of end customers (public) demand their own sizes for their beds which accordingly differentiates the size of the mattress too. In contrast to that the European market has only 3 standard sizes of mattresses and beds. 3. Accuracy. Since the mattress has to fit in the bed, the frame of it must be accurately produced. In that respect the machine has extreme accuracy and consistency is kept from one frame to another.

Major reasons for rejection as perceived by the MD were: 1. The very small production output of Greek firms which does not permit the efficient utilization of the machine. 2. The fact that the name of the producing firm had a very bad reputation in Greece. 3. The fact that many customers do not trust high technology machinery that have been produced in Greece.

<u>CASE STUDY TWO</u>

<u>PACKAGING MACHINERY</u>

2.1. *THE DEVELOPMENT OF THE INNOVATION*

2.1.1. *THE FIRM*

The origins of the firm in question can be traced back in 1976 when it was founded in Athens as a firm representing in Greece foreign manufacturers of food packaging machines. The founders and owners of the firm are two brothers. One of them is a mechanical engineer and he is the technical director (TD) of the firm and the other one who is a graduate of the Law School of the Athens University is the managing and sales director (MD).

The initiative for the establishment of the firm was given by the MD who after his graduation from the Law School did not want to be a lawyer but instead he wanted to have his own business. As he stated, due to his own background he realized that the increasing standards of living in Greece and the urbanization of the Greek population were creating an increasing need for packaged products. Therefore, he made a quick market research in the packaging industry and he found it to be a very growing sector. Moreover he found a very small number of small-sized trading companies selling machinery and equipment to this industry. The majority of the packaging machines were imported but there was not a dominant importing trading company in Greece and the already existed were badly organized.

The newly established firm had a great success and as the MD said the experience and knowledge they acquired within the first 2 years of their operation revealed to them an opportunity in own manufacturing. However since they had not yet either the technical knowledge or the necessary machinery and equipment for such an attempt they tried to approach other Greek firms seeking to collaborate with them. In this respect he made again a market research and finally in 1979 they approached a Greek company which was specialized in the service of cigarettes packaging machines. This company had recently produced the first Greek horizontally loaded cigarettes packaging machine and had a very good technical reputation. The approach resulted to a collaboration were ideas and orders for new packaging machines but for the food sector were given to this company by the firm in question. This "experiment", as it was characterized by the MD, was successful and within the next year they managed to sell 60 items of horizontally loaded packaging machines in the food sector. This success provided them not only with money resources but also made them keen to experiment even more.

Therefore, in 1980 they attempted another such collaboration with a company specialized again in the service of bottling machines.

In 1982 they built their own plant for the development of packaging machines for thick liquids i.e. honey, marmalade and yoghurt. Nearby to their plant there was a company owned by an old, self taught engineer who had managed to produce the first Greek vertically loaded packaging machine in the food sector. As the MD said despite the fact that this machine was a copy and not a very good one of a foreign machine, the attempts for its development in Greece provided to the old engineer a lot of technical experience and knowledge which he had transferred to 3-4 engineers that he employed. In addition this person had a very good reputation as an engineer but he had no selling proficiency at all, which in turn had created a lot of financial problems to his firm and eventually had forced him to seek retirement by selling his firm. According to the MD own word "this was the green light" for them and they bought the company in 1984. As he said they were aware that due to financial problems there has been no investments in that company and therefore its machinery and equipment were old and obsolete. However, he said, they bought the company not for the plant but mainly for the 3-4 experienced engineers and for its good reputation. One of these persons was given a share of the newly acquired firm and his knowledge contributed to a great extent to the development of the innovation which is an advanced model of the previously mentioned imitation.

Today (1989) this group of companies has 92 employees: 50 are technically skilled workers (degree from a technical college), 20 are unskilled workers, 7 are employed in the sales department at the head office (4 of them have a university degree) and 5 are mechanical engineers with a university degree and are employed again at the head office of the firm. This head office and the head of the group of companies is the initial trading company which still exists but it is trading only the group's products without representing foreign manufacturers any more.

2.1.2. THE INNOVATION

The innovative product in question is a vertically loaded machine for the packaging of a wide range of different products such as agricultural products e.g. beans, lentils, pastry goods, dried fruits and nuts; chemicals in powder form and in general products that can be packaged on a volume-metric basis. A brochure of this product with its technical specifications is provided at the end of this appendix.

According to engineers from the Hellenic Organization of Medium and Small Firms and Handicraft the packaging industry depends on precision engineering for the design and construction of its specialised machinery, on plastic technology for packaging materials and on electronics for functional controls. They explained that specialised machinery used in the packaging sector is mostly imported from other European countries. However, attempts have been made by few Greek companies to imitate constructing imported packaging machinery. To this end they indicated that the packaging machine in question is among the very few to attempt a genuine development of a new product and they explained that the innovativeness of this products can be traced to its flexibility in use and its technical characteristics i.e. speed, way in which it is loaded (volumetric), electronic numerically controlled.

2.1.3. *INCENTIVES FOR THE DEVELOPMENT OF THE INNOVATION*

As the MD stated the main motive for the development of this innovation was the export orientation of the firm. He explained that before the development of this machine their products were mainly imitations of foreign machines and although their quality (technical characteristics and design) was inferior to imported ones they were selling their machinery in the domestic market on the advantage of low prices. However, he added, when they attempted to make the first exports in European countries they realized the severe competition in it which was concentrated on the technical characteristics of the machines. Therefore, they had to innovate either by introducing a new machine or by applying new technology and making modifications on the existing ones. He stated that since their experience in developing new machinery by themselves was limited they decided in favour of the second alternative.

Another reason stated by the MD was the example of a German company which is one of their main competitors in packaging machines. The MD stated that this company had a remarkable record of innovations in packaging machines and its products were always a target for imitation. However, this company had not yet applied full electronic control over their packaging machines. This was perceived as an opportunity for the Greek firm to present something totally different from what was in the market already.

Furthermore the MD explained that the choice to apply the new technology on the specific machine, out of their range of machines, was made because vertically loaded packaging machines were the current international trend in the industry and by the fact that this machine makes the most difficult functions. The later was very important because as he said "if we were successful in applying new technology on this machine we then would be capable of making similar modifications to other machines in our range which are simpler functionally".

2.1.4. ENABLING CONDITIONS

The following enabling conditions for the development of the innovation were cited by the MD and the TD of the firm.

a) The previous experience they have gained by operating as a commercial firm and by collaborating with other firms for the development of packaging machines. This experience was useful in many respects. Firstly, by being a commercial company they had to have their own service department which eventually became very competent technically since they had to provide service for a wide range of machines which had different functions and different specifications. Secondly, by providing service they realized the technical disadvantages and problems of the machines of other manufacturers as well as the needs of their customers which were not satisfied by the existing machinery. Furthermore by collaborating with other already established firms they were able to transfer to each other experience and technical knowledge and to exchange ideas.

b) The skills of the technicians involved in the development of this innovation. These technicians were mainly employees of the firm and persons from another firm who assisted in the development of the electronic parts of the machine.

c) The organizational structure of the firm. As it was mentioned above there is a group of different firms which are managed by the headquarters at the initial commercial firm. In that respect the MD stated that the different firms in the group have a large degree of autonomy in respect to the technical works performed in each one and they can concentrate on production and technical operations since the commercial activities are performed by the headquarters. This provide them with the ability of pursuing different projects at the same time whereas the success or failure of one project does not affect the other. In addition they can employ at the headquarters mechanical engineers with a university degree who provide their knowledge to each of the other firms when is needed.

Another enabling condition stated by an engineer who participated in the development of the innovation was the innovative spirit and persistence of the TD and the MD (owners). He explained that the development of this innovation absorbed a large sum of money which despite of the uncertain outcome of the project, were provided by the owners mainly due to their risky, innovative and persistent character.

2.1.5. STAGES OF DEVELOPMENT/PARTICIPATING PERSONS & SOURCES OF INFORMATION USED

As the MD stated it took the firm 1 month to decide the various aspects of this innovation before the final decision for its development. According to the MD the idea for this innovation was initiated by himself in one of the regular meetings with members of the technical staff in the firm. He explained that the purpose of these meetings is to discuss with the most important technicians of the firm new ideas for the development of new machinery as well as to evaluate the new technical developments internationally and more specifically the developments introduced by their main competitors. During that meeting the idea was raised and despite doubts for its feasibility, raised by the technicians and the TD, he added that the idea seemed so attractive to him that he tried hard and persuaded everyone in the meeting to think about it more carefully. Among the arguments he used to persuade them was a last's year (1984) incident where again another idea of his was refuted as impossible by the technicians of the firm and while it was abandoned by them within the following months their main German competitor introduced a machine based on this very same idea.

This initiation stage was the most clear stage that could be identified by the MD in the respect that he was able to remember dates and arguments involved during the discussions. The remaining stages cannot be separated easily and as the MD stated the agenda for the meetings followed in the company included technical, financial and commercial issues. He added that "it is difficult to separate technical from commercial discussions since a technical issue such as achievement of a certain packaging speed, involved also financial and commercial considerations and vice versa".

Trying to identify then which issues in the above meetings were held as most important by the MD he stated that the starting point of each meeting was on technical issues raised by technicians and by himself and at the same time due to his knowledge and experience he was able to evaluate them financially and commercially and accordingly to suggest immediately which technical issue to be further pursued or not.

Furthermore the MD stated that more than 10 meetings took place which sometimes exceeded the period of 8 hours each. The persons that participated in these meetings were himself, the TD, two engineers from the plant and a mechanical engineer employed at the headquarters.

A large number of information sources were presented to the MD in order to find which of them were used during the stages of the innovation's development. The following table 2.1 illustrates these source alongside their importance per stage as stated by the MD. Where 1: the most important, 2: the second important source, and so on.

Table 2.1 : Information sources used at different stages of development.

Stages	Idea Initiation	Attributes Assessment	Technical Evaluation	Financial Evaluation	Commercial Evaluation
Prior studies of mine	2			1	1
Prior experience	1	3	1		
Formal contacts in firm		1	4	4	3
Personal formal contacts with members of other firms	3	2	2		
Contact with customers				3	4
Contacts with potential users					5
Market research				2	2
Technical journals		4	3		

2.1.6. FACTORS LED TO THE ASSESSMENT OF THE FINAL CHARACTERISTICS

The factors that contributed to the assessment of the final characteristics of the innovation alongside their importance as cited by the MD are illustrated in the following table 2.2.

The MD explained that the market research they conducted provided them information regarding the characteristics of the existing competitive machinery and their prices as well as information about the demands and needs of customers. These information outlined a wide spectrum of features the innovation ought to have in order to be attractive and of value to its prospective adoptors. However the final and feasible features of the innovation were decided mainly by the financial evaluation and by taking into account the technical capabilities of the firm.

Table 2.2.: Factors influencing the innovation's characteristics

Factors	Influence
Users' perceptions	2
Firm's technical capabilities	5
Firm's machinery & equipment	5
Market research	5
Financial evaluation	7

Scale 1 to 7 were 1:not at all, 7:to a great extent

Furthermore, the MD stated that since a competitive advantage of the company was its lower prices their objective was to produce a technically competitive machine without increasing its price to a great extent. However the market research regarding the needs of customers had shown that Greek firms wanted a machine that could be both flexible (packaging of different products), cheaper than the imported ones and of high speed. Instead, foreign firms were willing to pay a premium price for a product dedicated machinery but with high speed. In addition specific customers had expressed needs which were applying only to their individual situation. As the MD explained, "if these contradictory customers' needs were taken seriously into account they would have led us to a dead end". Therefore these information were used only as general guide-lines in order to develop their own perceptions of what features the machine should have.

2.1.7. FINANCIAL AND COMMERCIAL EVALUATION

The financial and commercial evaluation of the innovation was made mainly by the MD. Regarding the financial evaluation the MD stated that return on investment and payback period were the two main financial indicators used in his analysis. As he mentioned both indicators were very difficult to be calculated because the whole attempt to develop the innovation was very risky and he did not know whether they would have had to spent more money on it than it was estimated in advance. He added that according to his calculations both indicators were in favour of the development of this innovation. However, he explained that during the actual stages of development the problems that appeared forced the firm to spent large amounts of money that were not anticipated. Characteristically he stated that "if at that time I had known exactly the amount of money I was going to spent for the development of the innovation probably I would had not undertaken it."

Regarding the commercial evaluation of the innovation the MD explained that it was based on comparisons of its characteristics with those of the competitors' machinery. The anticipated volume of sales was calculated with extrapolations of the firm's past sales regarding other machines and a qualitative element used was the fact that in comparison with competitive imported packaging machines this machine was technologically more advanced while its price was much lower. In addition the number of potential customers for the innovation was assessed by the MD through discussions he had with the already customers of the firm who showed immediately a great interest to buy the innovation.

The innovation absorbed 100% of the R&D resources spent by the firm during the period of its development. Interestingly the development was financed by the firm without any external help from banks or governmental institutions. To this end the MD explained that they did not use any bank loans because at that time the interest rate was very high. Regarding government developmental funds he stated that firstly, his firm was not eligible to use most of them since it was based in Athens and secondly, he did not trust the governmental institutions since they "do not function efficiently and there are many delays in their decisions due to bureaucracy". However it was noticed that although they had made contacts with the Hellenic Organization of Medium and Small Firms and Handicraft they did not used any developmental funds rather they used their financial help for the commercialization of the innovation i.e. participating in foreign exhibitions. In conclusion the MD stated that the firm's policy is to finance any development by its own resources since this brings a relative pressure on every attempt which in fact acts as a factor in favour of its quick execution.

2.1.8. FACTORS LED TO THE FINAL DECISION TO DEVELOP THE INNOVATION

Thirteen factors were presented to the MD in order to find which and to what extent each of them had influenced the final decision to develop the innovation. A scale from 1 to 7 was used to assess the extent of influence for each factor, where 1: not at all and 7:to a great extent. Table 2.3 illustrates the degree of influence of each factor as it was marked by the MD.

Table 2.3.: Factors influencing the final decision to develop the innovation

	Factors	Influence
1	R.O.I.	7
2	Payback period	6
3	Profit per unit	1
4	Compatibility with our production capabilities	7
5	Compatibility with our technical knowledge	7
6	Competitive activities	7
7	Good market response	7
8	Large number of potential adopters	7
9	Low failure risk	4
10	Vital for firm's image	7
11	It was a technical challenge to the GM	7
12	General trends in industry	7
13	Ease of patentability	1

Scale 1 to 7 were 1:not at all, 7:to a great extent

Two points of interest arise from the above table; the low degree of influence of the profit per unit and the equally low influence of the ease of patentability. Regarding the profit per unit, the MD explained that policy of the firm was to sell as many as possible items of this machine. Therefore, they were seeking profits out of sales volume and not profits per unit. He added that although they could have achieved more profits per unit by charging a higher price they preferred a lower price in order to provide an economic incentive to Greek firms also in order to buy the product. Regarding the ease of patentability he stated that "firstly, international patents are very expensive and secondly, since we are able to copy even patented foreign machines we know that the same will happen sooner or latter with our innovation too. Therefore we seek to exploitate as much as possible our temporary competitive advantage by selling as many machines we can and to acquire technical experience which by the time this machine will be copied will enable us to introduce something better".

2.1.9. PROBLEMS DURING THE DEVELOPMENT

As it was stated by the TD the firm faced three kinds of problems during the development of the innovation.

a) The most important problem was the lack of components for the innovation. As it was explained special components needed for the innovation were either not imported in Greece or were imported in very small quantities. Therefore they had many delays and they spent a lot of money in order to find, buy and store these components, since the Greek importing companies were asking premium prices for the import of components which were not of wide use. The TD made a comparison between Greece and the neighbouring country of Italy. He stated that in the Italian domestic market one can find the 80% of the components used for the development of new machines while in Greece the respective percentage is only 3% .

This problem was solved in part by making their own tooling in components and by appealing straight to the foreign manufacturers of these components for better prices on the basis of their developmental efforts and the future increasing orders. However delays were suffered for the additional reason that they had based the production of the innovation on components which were in the Greek market but the importing company ceased to import them, or because their production had stopped and the supplier failed to inform them on time.

b) In addition they faced many technical problems which were related to the application of the electronic characteristics of the innovation. These technical problems were solved through consultations in the firm among technicians and by seeking the help of another firm in Greece which was specialized in electronics.

c) Finally they faced financial problems since the innovation needed an extensive testing. The machine was tested for more than 8 months and as the TD stated during this time the firm spent large sums of money without any inputs since the machine was not for sale yet.

1.10. CHARACTERISTICS OF THE INNOVATION AS PERCEIVED BY THE PRODUCER

The following table 2.4 illustrates the extent to which the machine meets a number of attributes. The scale used is from 1 to 7, where 1:not at all and 7:the machine meets the specific attribute to a great extent.

As it is obvious from this table the overall rating of this innovation by the MD of the firm is very high. Regarding the features that were rated below 7 the MD made the following remarks.

The price of the innovation is relatively higher than the price of other machines the firm is selling. He added that this was inevitable since the innovation was developed by the use of very advanced technology and its performance is outstanding. Furthermore the MD stated that although its price is high for a Greek adoptor, it is still lower than the price on which imported machines with competitive features (mainly speed) are offered. The high price of it for the Greek adoptors was also mentioned by the MD as a reason which reduces the trialability of the innovation.

Table 2.4: Perceived innovation's characteristics

	Characteristics	Extent
1	Low initial cost	4
2	Low maintenance cost	7
3	Low pay-off period	7
4	High flexibility in use	7
5	High reliability in operation	7
6	Ease of understanding its use	7
7	Labour savings	7
8	Product quality improvements	4
9	Space savings	4
10	It is compatible with existing manufacturing operations	7
11	It is compatible with the existing technical experience and expertise	7
12	Lowers the unit cost of end product	5
13	Permits trial in small scale	-
14	Provides better equipment utilization	7
15	Introduces savings in production time	7
16	Increases variety of end products	7
17	It encompasses advanced technology	7

Regarding space savings, the space occupied by the machine is the standard space that vertically loaded packaging machines occupy in a factory. In that respect the machine hardly has any competitive advantage over imported ones.

Regarding the quality of the end product the MD stated that this depends more on the quality and other features of the product to be packaged, the material used for packaging and the conditions of the factory i.e. dust. He added that the machine has a high flexibility in accepting a variety of products to be packaged and different packaging materials. Although the machine is offered as a standard, modifications are possible in order to meet better the specific conditions of a customer and the products he wishes to package. This increases the flexibility of the machine but as the MD stated not every demand of a customer is considered in that respect. Therefore, modifications that are not considered by the firm of wide application in the industry are not performed. Finally, due to its speed, when the innovation is a part of production line it increases the utilization of other machinery which in turn decreases the overall production time.

2.2. *THE MARKETING OF THE INNOVATION*

2.2.1. *A GENERAL DESCRIPTION OF THE MARKETING EFFORTS*

The MD stated that the marketing efforts for this machine started immediately after the development and testing of it in the firm. On the question whether there were any promotional communications with potential customers during the development and testing of it he replied negatively. He explained that such activities have not been undertaken because: a) the whole attempt was so innovative and risky that they did not know whether they would produce exactly what they were planning. In addition they wanted to avoid pressures from customers to buy the machine before its final and extensive testing. He stated that this had happened in the past and it was damaging to the firms reputation because a machine which is not thoroughly tested is bound to have problems in operation b) they wanted to avoid delays in customers decisions regarding their other products which due to the development of this machine were going to be if not obsolete at least inferior c) they wanted to avoid an early competitive reaction through the early copying of the machine by their competitors. Therefore, only after the testing of the machine, the firm invited its most important customers to its premises to see it in operation. The next step was the participation in domestic and international exhibitions where their visitors addresses were recorded and within the next few days they were sent a direct mail with a brochure of the machine, its technical specifications and information regarding the services provided by the firm as well as regarding the economic conditions for its purchasing.

It is of great interest that the firm has not door-to-door personal salesmen, although occasionally the TD and the MD visit some of their potential customers and inform them about their products.

2.2.2. *FORMALITY OF MARKETING EFFORTS*

The MD stated that the marketing efforts followed by the firm are not written anywhere. However a certain degree of formality can be attributed to these efforts since: a) the procedure - invitation of important customers in the firm, participation in domestic and international exhibition and direct mail - is a fixed procedure followed by the company in the past and present.

Regarding the direct mail it was explained that they have developed a standard format of letter which is send to their potential customers. Whenever this letter is send to already customers, the conditions of which are known to the firm, this letter becomes more personalized with statement for specific problems that the customer is facing in his operations. Although it was stated that they would like to have more personalized letters for their potential customers too, it was explained that this was difficult due to the amount of work needed for that and due to the fact that when participating in exhibitions they have not developed a way for recording the personal needs and enquiries of their visitors. Instead they take the addresses of their visitors from the management of the exhibition.

A degree of formality also exists in their selling methods. The MD explained that they use the services of another firm in Greece in order to evaluate each potential customer financially. This evaluation takes place always before the actual selling agreement and since that company keeps records of many Greek firms this can be done sometimes within a matter of minutes.

Finally a degree of formality can be attributed to the firm's export activities which are based upon exclusive representation in foreign countries. Their practice is to seek such representatives in foreign countries who are then forced to buy one machine for presentation in their premises. These representatives are invited to submit long before the beginning of each year an estimate of their sales for each type of machinery and these estimates are projected by the firm for its yearly production schedule. The representatives' allowance is 15% on the price that the machine is sold to them. Today the company has exclusive representatives mainly in Middle East and Northern African countries such as Turkey, Saudi Arabia, Bahrain, Kuwait, Sudan, Dumbai etc.

2.2.3. INFORMATION MEDIA USED AND PROBLEMS

Thirteen different information media were presented to the MD in order to find which and to what extent each of them has been used by the firm in order to communicate the innovation among the potential adoptors. A scale from 1 to 7 was used to assess the extent of use for each medium, where 1: not at all and 7:to a great extent. Table 2.5 illustrates the extent of use of each medium as it was marked by the MD.

The MD explained that from the information media they used, trade shows were the most effective although the most expensive. He added that in trade shows the firm was not only able to find many potential customers and their addresses to be used later for direct mail, but also it was able to find representatives for its products in different countries.

Table 2.5 : Information media used

	INFORMATION MEDIA USED	USE
1	Brochures and Leaflets	7
2	Trade shows	7
3	Trade journals	1
4	Technical journals	1
5	Scientific journals	1
6	Personal contacts in professional associations	7
7	Participation in conferences	7
8	Contacts with Universities	1
9	Contacts with governmental institutions	1
10	Informal contacts with customers	7
11	Formal contacts of other firms' managers	7
12	Sales force contacts of potential customers	1
13	Direct mail	7

Scale 1 to 7 were 1:not at all, 7:to a great extent

Regarding the direct mail he stated that it is used on a daily basis and alongside the formal letter, brochures and leaflets of the innovation in question are included. According to him, direct mail is not as effective as the trade shows because the potential customer cannot see the innovation in operation and thus to form immediately a positive attitude. Instead the direct mail will result to sales when the conditions in the customers' operations will force him to think the adoption of a packaging machine and he will start searching his files for letters and leaflets. To this end the MD stated that customers have appeared to his firm possessing brochures and leaflets sent to them two or even more years ago.

Furthermore the MD explained that their major problem is the financing of their participation in trade shows world-wide. He stated that the expenses faced by the firm concern both the rental prices for the space it occupies in the exhibition and the transportation costs for its products which due to their large volume is very costly. In that respect they sought governmental help, but due to bureaucratical methods used in governmental institution they used such help only once. However since they have very good connections and good reputation within the banking sector in Greece they are able to take credit from their bank in order to finance such attempts.

Regarding technical, trade and scientific journals he mentioned their lack in Greece and added that from his experience he knows that the few existed are not consulted to a great extent by their customers.

2.2.4. INFORMATION MESSAGES USED

Regarding the information messages used by the firm the MD was asked to indicate on a scale from 1 to 7, the extent in which these messages included the elements which are illustrated in the following Table 2.6.

Table 2.6 : Information messages used

	INFORMATION MESSAGES USED	Content
1	Technical characteristics	7
2	Financial opportunities	7
3	Competitive advantages	7
4	Industry trends	7
5	Company's reputation	7
6	R&D allocation	7
7	After sales service	7

Although according to MD's perceptions each of the above elements is included to a great extent in the information messages he noticed that they pay more attention the after sales service they offer, the industry trends and the competitive advantages to be gained by the use of the machine.

Regarding the after sales service he mentioned that this is one of the main competitive advantages of his firm since the main competitive products in Greece are imported by small importing firms which lack the ability and the technical knowledge to offer adequate after sales services.

Regarding the industry trends he explained that since many potential adoptors are small-sized newly established firms they do not know very well the packaging industry and the technological achievements in it. Therefore, by providing information about the industry, the machinery and materials used domestically and internationally, they increase their customers' knowledge and in turn their receptivity to the innovation in question.

2.2.5. SEGMENTATION AND RELATED STRATEGIES

The MD stated that the firm has not developed any segmentation strategy. In general they sell this innovation and their other products to the whole market irrespective of firms' size or geographical position.

However a kind of segmentation was identified by the fact that very large companies in Greece are not approached. The reason stated for that is that these companies due to the large size of their plants and their good financial position are capable of obtaining favourable purchasing terms from foreign large manufacturers on which the Greek firm finds hard to compete mainly due to its small size. Again due to the size of the large firms' operations only large with high speed packaging machines are appropriate for them. In contrast the packaging machines manufactured by this company are somewhat slower but are of greater precision and flexibility in operations.

Whereas very large firms are avoided the MD stated that firms of medium size are a main target for them since selling their products to these firm increases their reputation in Greece. Again a selling strategy followed by the firm is to approach its already customers when introducing a new machine in the market.

The financial help that the firm offers to its customers is the acceptance of 30% of the total value of the innovation when the agreement is made, 30% upon delivery and the rest 40% within the next 6-8 months. As it was stated by the MD in the case of a customer with limited resources and borrowing capability they help him to seek finance from banks under good conditions through their connections in the banking system.

Technically they provide the installation of the machine and they train extensively the person who is going to use the machine. The later is regarded very important by the firm because as the MD said "ignorance of the use of the machine is oriented both towards the machine and the firm because the customer always blames the firm and the machine for occasional break-downs that might result from his inability to operate properly the machine".

2.2.6. PERCEPTION OF CUSTOMERS' RISK AND HANDLING METHODS

Regarding the customers' perceived risk the MD stated that it is low since the company is well known and with good reputation in the market. However they take it into account (point 4 on a scale from 1:not at all, to 7:to a great extent) and they use the methods illustrated in the following table in order to eliminate it and to assure the customer for a good collaboration.

The MD explained that the most effective methods are the visiting of other customers operations that already adopted the innovations and the after sales service.

Table 2.7:Risk handling methods

	RISK HANDLING METHODS	USE
1	Visit operations	7
2	Visit other customers	7
3	Accept penalty contracts	4
4	Provide technical information	7
5	After sales service	7
6	Trial	1

Scale 1 to 7 were 1:not at all, 7:to a great extent

Regarding the visiting of other already adoptors it is the policy of the firm to ask their most important customers to accept in their firms other potential customers in order to see the machine in operation. However as the MD stated this is sometimes very difficult due to the fact that some of these companies compete with each other. Regarding after sales service they provide it free for 1 year, which is more than that of any other company, and they provide a warranty for the existence of components and technical help whenever is needed.

In addition the firm used the method of trial at the early beginning of the introduction of the machine. The MD said that they used this method heavily in the past with their other machinery and they are always willing to use it, if it is asked by an important customer.

2.2.7. AFTER SALES FEED-BACK & ADJUSTMENTS

Both the MD and the TD mentioned that they monitor the performance of the innovation after its sale to a customer. They stated that this is a formal practice of their firm and that it has contributed to a great extent both in technical and marketing terms.

The TD said that the contacts they made with their customers who adopted the innovations enabled them to realize possible technical modifications that could increase the reliability, speed and in general the attractiveness of the innovation to their customers. In that respect they noticed the need for alternative ways of readjusting the machine's specifications according to the packaging material used, kind and quantity of product to be packaged and speed of the machine in relationship to other machines connected with it. Responding to these needs they introduced more advance technology in the machine and the new versions of it are computer numerically controlled.

Regarding the marketing efforts they noticed that many customers were using packaging materials which were of bad quality and thus problems were created both to the operation of the machine and the competitiveness of the packaged products in the market. Therefore alongside the technical and other information about the machine they offer information about the existence and appropriability of packaging materials for the products of their customers.

The MD said that this after sales monitor of the innovation has been received very well by their customers who by word of mouth communication introduce the firm and the innovation to other prospective buyers. Thus each year a 25-30% of their sales is from buyers who are introduced to them by their already customers.

2.2.8. VISITS PER SALE/PERCENTAGE OF SALES AND MARKETING BUDGET SPENT FOR THAT INNOVATION/PERCENTAGE OF ADOPTORS THAT WERE ALREADY CUSTOMERS OF THE FIRM

As it was mentioned above the firm has no sales force. However as the TD said before any sale, technicians from the firm visit the customer's operations in order to see the place where the machine will be installed, other machines which will be connected with it, the products to be packaged and the packaging materials to be used. He added that although the machine is offered as a standard usually the firm has to make some minor modifications in order to satisfy the specific needs and conditions of the customer.

Regarding the resources absorbed for the marketing of this innovation the MD stated that 30% of their sales and marketing budget is spent for this innovation each year. The MD stated that 30% of the adoptors of this innovation were already customers of the firm.

2.9. MAJOR REASONS FOR ADOPTION OR REJECTION AS PERCEIVED BY THE PRODUCER

According to the MD the following 5 reasons were most important for the adoption of the innovation:

1. Technical reasons, which include the high speed of the machine, the reliability in use and its easiness in use.

2. Its price which is less than that of competitive foreign packaging machines offered in the Greek market.

3. The fact that the firm is keen to make any modifications on the machine in order to make it compatible with the needs of customers which differ from each other according to the product to be packaged and the conditions of their factory.

4. The good reputation the firm enjoys in Greece.

5. The good after sales service that the firm is offering.

The MD attributed the decision of some companies to reject adopting this innovation to the following reasons:

1. Customers are not receptive in accepting a technologically innovative product which has been produced in Greece because of the fact that Greece has not a good record in producing innovations. The MD explained that packaging machines of inferior technology which are produced by small firms of Germany or Italy are regarded as more reliable than theirs because of the industrial name and good records in innovations of these countries.

2. The high competition which the firm is facing from competitive Italian firms. According to the MD the geographical proximity of Greece with Italy allows the Italian firms to offer sometimes good after sales technical services and thus they attack one of the major competitive advantages that his firm enjoys in Greece.

3. Many potential customers in the Greek market are young entrepreneurs who lack the technical experience and knowledge of the technological achievements in the packaging sector. Therefore they are sceptical in accepting an innovative product and they prefer the "old and reliably proven" packaging machines that are in the market. However the MD added that these very customers call back for the machine after they face the first problems with these old and largely outdated packaging machines that have acquired in the first place.

4. The newly established packaging firms in Greece due to their small size have a small production output and therefore, the competitive attribute of speed that the innovation in question enjoys as compared to similar machines is irrelevant for their decision. Therefore, they prefer a slower machine which of course is much cheaper than this innovative one.

CASE STUDY THREE

POWER SUPPLY SYSTEMS (SMPS)

3. *THE DEVELOPMENT OF THE INNOVATION*

3.1. *THE FIRM*

The firm was established in Athens, Greece in 1987 for the exclusive design, development, production and commercialization of switching power supply systems (SMPS).

Two electrical engineers are the founders and owners of the firm. One holds the position of the Research and Development director (indicated as TD in the remaining parts of this case), and the other one holds the position of the Production manager (PM). In addition to the above functional positions there is a sales director (SD) and she is in charge of the marketing, promotion and selling activities of the firm.

Before the establishment of the above firm the PM and the SD, who are a couple, had their own small commercial firm importing electronic parts. Among their suppliers was one of the largest US companies producing power supply systems. The technical director of this company, in charge of the design department for the last 15 years, was a Greek electrical engineer with whom they developed close contacts. His decision to move back to Greece alongside his willingness to create a company in Greece for the production of supply systems was the main incentive for the establishment of the firm in question. As mentioned above he is the TD of the firm and his decision to collaborate with the PM and SD was justified by him on the basis of their knowledge of the Greek market. As he explained in his own words "my experience on power supply design issues alongside their commercial knowledge and contacts in the Greek market were perceived as very promising factors for the success of the newly established firm despite the very unfavourable Greek business environment for high technology firms". The TD added that they realised this adverse environment very early when they attempted to raise some additional capital from governmental sources and developmental institutions in Greece. However, these unsuccessful attempts did not stop them and they finally financed the establishment of their firm with their own capital.

Today (1989) the firm employees 15 persons of whom 13 are employed in the design and production departments while 2 persons are allocated to the sales and marketing department of the firm.

3.1.2. *THE INNOVATION*

The innovation in question (power supply system) is not a single product but a range of products all of which have been produced with the same advanced switched mode design technology as opposite to the old linear mode. The power supply system is a necessary component of every electrical device since it is responsible for meeting the power requirements for its operation. The essential function of a supply system is to convert the incoming line power as required by the operating device i.e. direct current to direct current converter, direct to alternating current converter, off line alternating current to direct current converter.

The main advantages of a switching power supply system to a linear one is its efficiency in operation and its size which both contribute to its lower cost than that of the linear one. A comparison between a linear and a switching power supply system is provided in the following figure 1.

FIGURE 1: Power supply comparison

PARAMETER	LINEAR	SWITCHER	UNIT
SIZE	0.5	2	Watts/In
EFFICIENCY	40-55	60-85	%
POWER DENSITY	10	50	Watts/Pound
RIPPLE NOISE	30	50	Millivolts
LIFE CYCLE CARRYOVER	2	25-50	
TRANSIENT RECOVERY TIME	25	500	Microseconds
INPUT VOLTAGE TOLERANCE	± 10	± 20	%
REGULATION	0.1	0.1	%
GENERATED RFI	None	High	-

Source: Wilhelm, R. Jr., (1984), "Programmable controller handbook", Hayden Publishing Company Inc., New Jersey

According to engineers in the Hellenic Organization of Medium and Small Firms and Handicraft (HOMSFH) the technological evolution of the power supply systems depends upon the technological improvements of the materials used for its production. To this end they referred to magnetic materials, power semi-conductors (MOSFET), transistors, topologies of power supply systems and design techniques. In their evaluation of the innovativeness of the supply systems produced by the firm in question they referred to its design mode (switching vs linear), its components which were in the forefront of technology and to its overall design which contributed to its high efficiency, reliability and safety in operation.

3.1.3. INCENTIVES FOR THE DEVELOPMENT OF THE INNOVATION

The main incentive for the development of these SMPS it was the recognition of a fast growing domestic and international demand. As the SD explained the firm made an extensive market research in Greece and bought many international market research studies. According to these studies[1] * the international market for power supply systems in 1980 was 4 billion US dollars while in 1982 it was 7.5 billion dollars (an 87.5% increase). Furthermore according to the Frost and Sullivan's market research a 300% increase was expected during 1986 to 1990 for the international market for power supply systems.

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[1] a) LAMBDA ELECTRONICS-VEECO INSTRUMENTS INC. 1980 ANNUAL REPORT,
b) THE EUROPEAN MARKET FOR POWER SUPPLY MODULES WITH SEMICONDUCTORS, FROST AND SULLIVAN LTD., LONDON.

The same research indicated that while for the year 1984 the balance between linear and switching systems used internationally was 50-50, it was expected to be 75-25 in favour of the switching systems by the year 1990. Regarding the Greek market for power supply systems the market research indicated that it was more than 200 million drachmas yearly.

According to the SD the estimated growth of the market for SMPS was proved true and this is depicted on the following figure 2 which illustrates the market of SMPS during 1986 to 1988 for 6 highly industrialized countries according to the international journal of Electronics.

FIGURE 2 : The market for SMPS (in million dollars).

COUNTRY	1986	1987	1988
USA	640	850	1020
JAPAN	1707	1985	2165
W. GERMANY	144	181	213
BRITAIN	52	59	63
FRANCE	32	36	41
ITALY	27	30	33

Furthermore the market research indicated that while in year 1980 the majority of firms internationally were producing by themselves the power supply systems for their own products the future trend was in favour of the establishment of firms producing exclusively power supply system.

The SD stated that the above figures as well as the lack of a similar firm in Greece was the main incentive for their attempt to develop the Switching power supply systems. Another incentive mentioned by the PM was the realisation of problems faced by Greek firms using imported power supply systems. These problems were realised by him through his previously mentioned trading company and had to do both with the performance of the old linear supply systems as well as with their characteristics (size, output etc.).

Finally, both the PM and the TD mentioned that a main incentive to the development of the SMPS's was the fact that they had considerable advantages over their main foreign competitors. These advantages were regarding their lower cost of production which was a result of both the lower labour cost in Greece than abroad and the invaluable design skills of the TD which were accumulated through his vast experience in the field.

3.1.4. ENABLING CONDITIONS

The TD stated that the most important enabling condition for the development of the innovation was his technical knowledge and his experience accumulated through his work in an American company which is the largest producer of power supply systems in the world. He added that the most important aspect of the development of an SMPS is the actual design of it which requires not only advanced technical knowledge but in addition vast experience.

The second important enabling condition was the knowledge of the market and the customers' needs and problems. This has been attributed by the SD to the previous commercial company they had. By trading power supply systems she and her husband were able not only to create important connections and reputation in the industry but also to identify the specific needs of the customers which were not fully satisfied by the power supply systems already existed in the market. Therefore, immediately after the establishment of the firm they knew where to concentrate their research and developmental efforts.

A third factor that was cited from the SD was the large diversity of customers' needs. She mentioned, as an example, the computer manufacturers and stated that changes of the output required by the computer as well as changes in the body of it specify the body and other specifications of the SMPS. Due to the standard ranges of SMPS that exist in the market it becomes very difficult for the computer manufacturer to find the most appropriate SMPS and therefore sometimes they have to adjust their computer in order to accept a specific SMPS. She explained that most computer manufacturers regard the SMPS as a minor component and they do not take it into account at the very early stages of the computer's development. Later they realize that they can not find a standard SMPS to fit their specification and thus they have either to redesign some aspects of their computer or to seek the development of a new SMPS to fit their specifications. However large foreign companies decline to accept such individual proposals of low sales volume because their orientation is profit maximization through cost reductions from large production orders. She added that since their firm is a small one it considers every customer's request and this alongside their technical skills enabled the development of technologically very advanced products.

3.1.5. STAGES OF DEVELOPMENT/PARTICIPATING PERSONS & SOURCES OF INFORMATION USED

The SD explained that whereas the development of a power supply system can take 7 to 9 months the initial stages before the final decision to develop it takes only a few days (7-15).

Regarding their first SMPS, they produced she stated that the whole process started within the sales and commercial department of the firm where the potential market was assessed. Due to the technical nature of the product the role of the TD at this stage was essential since he outlined the general technical characteristics of the product to be produced and according to these characteristics (mainly output) the relevant market segment was assessed.

The next stage took place mostly in the technical department of the firm where the TD and technicians of the firm decided its final technical characteristics alongside the cost estimates for its development and production. This stage resulted, among other, to an accurate description of the developmental works to be performed and of the different components to be purchased. These information where then used to develop an estimate of the unit cost of the

SMPS which alongside the marketing and sales expenses and the expected sales volume determined the actual price of the SMPS for the end customers.

As it was explained by the SD any decision during the stages of development are taken collectively by members from both the technical, production and sales department.

Regarding the other products in their product range the initial stages of their development follow the same procedures. However since most of them have been proposed by specific customers the commercial evaluation is the most important stage since it is unprofitable to produce a SMPS only for one customer who inevitably will require a small number of them.

A large number of information sources were presented to the SD and TD in order to find which of them were used during the stages of the innovation's development. The following table 3.1 illustrates these source alongside their importance per stage as stated by the SD and TD. Where 1: the most important, 2: the second important source and so forth.

Table 3.1 : Information sources used at different stages of development.

Stages	Idea Initiation	Attributes Assessment	Technical Evaluation	Financial Evaluation	Commercial Evaluation
Prior studies of mine	1	1	1	1	4
Prior experience		2	2	2	3
Formal contacts in firm	5	3	4	4	4
Contact with customers					2
Contacts with potential users					2
Market research	2	5		3	1
Technical journals	3	4	3		
Scientific journals	4				

3.1.6. FACTORS LED TO THE ASSESSMENT OF THE FINAL CHARACTERISTICS/ FINANCIAL AND COMMERCIAL EVALUATION

The factors that contributed to the assessment of the final characteristics of the innovation alongside their importance as cited by the TD are illustrated in the following table 3.2.

Table 3.2.: Factors influencing the innovation's characteristics

Factors	Influence
Users' perceptions	3
Firm's technical capabilities	7
Firm's machinery & equipment	7
Market research	4
Financial evaluation	5

Scale 1 to 7 were 1:not at all, 7:to a great extent

The TD explained that the firm's technical capabilities (know-how), its machinery and equipment and the financial evaluation of the innovation determined mainly the characteristics of it. Specifically, he stated that whereas their Know-how was acting as a facilitating mechanism they were constrained by the firm's machinery and equipment and the financial evaluation of the innovation. Regarding the later he mentioned that components necessary for the development of the SMPS cannot be found in Greece and they have to be imported. However the more specialized the component are and the more advanced in technology the more difficult it is to be found in small quantities and the more expensive they are. Therefore, since they wanted their products to be competitive pricewise with those from Europe and USA they had to balance the cost with the characteristics of the innovation.

Regarding the market research the TD stated that it was very helpful in the respect that it allowed them to know the industry's trends internationally, and domestically to assess the potential demand of each specific product in their product range.

Finally the customers' perception did not contributed a lot to the assessment of the final characteristics mainly due to the lack of knowledge of the technology by them. Their contribution was more vital in explaining the problems they were facing with other SMPS and in providing information regarding their own product specifications i.e. size, output needed, safety standards etc.

3.1.7. FINANCIAL AND COMMERCIAL EVALUATION-R&D RESOURCES SPENT AND USE OF EXTERNAL HELP

Regarding the financial evaluation of the SMPS the SD explained that they used the techniques of ROI, Payback period and they decided the break-even point between cost of development and units to be sold. She added that although her experience in using these techniques was limited she acquired many useful insights from seminars in finance and marketing that she recently attended. From the above techniques she found more interesting the payback period and she attributed that to the lack of resources of the firm. She explained that the later necessitated the quick recovery of the resources spent in the first place in order to be ready to finance the next development.

Regarding the commercial evaluation it was mainly based on market research that she undertook through her own previous commercial experience and by using different published data. She explained that since the firm had clear strategic objectives, i.e. on which output ranges will attempt to develop its SMPS, a qualitative evaluation against that was taken place each time a customer was proposing the development of a specific SMPS. In that respect the firm faced a conflict between SMPS with existing output ranges and those on new output ranges. She mentioned that proposals on the existing output of their products were more tempting and profitable since the developmental works were only minor modifications to the size of the SMPS. However proposals on ranges out of the existing ones had a strategic value for the company since they wanted to increase their product range. She concluded that many times the company preferred the second option at the cost of the first one since the machinery and equipment as well as the number of employees did not allow the simultaneous exploitation of both of them.

The first SMPS produced by the firm absorbed 100% of its R&D expenses and the finance of it was achieved by using their own resources and by taking grants from the EOMMEX and the Ministry of Industry Research and Technology. The SD stated that this external financial help was not very much but it was very helpful from a financial and a marketing point of view. She explained that since this help is taken only after the technical evaluation of the product by these institutes they could use their evaluation as a selling point for their customers. On a scale of importance from 1 to 7, where 1:not important at all and 7:of great importance, she assessed the importance of this external financial help as 5.

3.1.8. FACTORS LED TO THE FINAL DECISION TO DEVELOP THE INNOVATION

Thirteen factors were presented to the TD and SD in order to find which and to what extent each of them has influenced the final decision to develop the innovation. A scale from 1 to 7 was used to assess the extent of influence for each factor, where 1: not at all and 7:to a great extent. Table 3.3 illustrates the degree of influence of each factor as it was marked by them.

Table 3.3.: Factors influencing the final decision to develop the innovation

	Factors	Influence
1	R.O.I.	4
2	Payback period	5
3	Profit per unit	4
4	Compatibility with our production capabilities	7
5	Compatibility with our technical knowledge	7
6	Competitive activities	7
7	Good market response	7
8	Large number of potential adopters	7
9	Low failure risk	6
10	Vital for firm's image	5
11	It was a technical challenge to the GM	7
12	General trends in industry	7
13	Ease of patentability	2

Scale 1 to 7 were 1:not at all, 7:to a great extent

The TD explained that the most important factors were the general trends in the industry, the good response from the market and the compatibility of the innovation with their technical and production capabilities.

Regarding the ease of patentability the TD stated that this was irrelevant in their decision to develop the innovation for the following reasons: a) patents are very expensive to be acquired and the firm had not the money resources for them, and b) the innovative characteristics of the SMPS they produced were not related that much to the components they were using, but they were related to the design they were applying which was very difficult to be copied by another firm.

3.1.9. PROBLEMS DURING THE DEVELOPMENT

The most important problem cited by the TD was the lack of raw materials in Greece necessary for the development of the SMPS. He explained that components specific for the development of SMPS cannot be found in the Greek market and therefore they have to import them. This eventually increases their cost and causes delays to the development process. He added that since the practice of the company is to develop first a prototype to be tested both in the firm and in the customer's operations they are unable to order large quantities of components and thus to gain in cost via economies of scale.

A second problem stated by the TD was the fact that both lack of resources and lack of appropriate space for their operations resulted to the purchasing of machinery and equipment with small production output. However the success of the company brought the first large orders which the firm was almost unable to meet. Thus they found themselves instead of spending time in the design and development to spend more time in the actual production of their products. In addition due to lack of space they were unable to have advanced machinery for the quality control of their products. This caused a lot of problems and delays in the development and testing of prototypes.

3.1.10. CHARACTERISTICS OF THE INNOVATION AS PERCEIVED BY THE PRODUCER

The following table 3.4. illustrates the extent to which the power supply systems meet a number of attributes. The scale used is from 1 to 7, where 1:not at all and 7:the innovation meets the specific attribute to a great extent.

Table 3.4: Perceived innovation's characteristics

	Characteristics	Extent
1	Low initial cost	7
2	Low maintenance cost	7
3	Low pay-off period	7
4	High flexibility in use	1
5	High reliability in operation	7
6	Ease of understanding its use	-
7	Labour savings	-
8	Product quality improvements	7
9	Space savings	-
10	It is compatible with existing manufacturing operations	7
11	It is compatible with the existing technical experience and expertise	7
12	Lowers the unit cost of end product	5
13	Permits trial in small scale	7
14	Provides better equipment utilization	-
15	Introduces savings in production time	-
16	Increases variety of end products	-
17	It encompasses advanced technology	7

Scale 1 to 7 were 1:not at all, 7:to a great extent

3.2. THE MARKETING OF THE INNOVATION

3.2.1. A GENERAL DESCRIPTION OF THE MARKETING EFFORTS

According to the SD the firm started to communicate the existence of its products immediately after their development. This took the form of brochures and leaflets with the technical characteristics of the innovation and direct mail with information about the company its technical capabilities and objectives.

On the question whether the firm undertook any promotional activities during the development of the product the SD mentioned that they participated in conferences where they explained both the new technology as well as the trends in the industry and the formation of their company which was currently undertaken research and development on this technology. Furthermore members of the firm started to communicate informally, to their already customers from the old trading company they had, the existence of this firm and the prospective production of a Switching power supply in Greece.

The next step after the development of the SMPS was to advertise it in different Greek and international trade and technical journals and in addition they attempted to get the first international safety approvals. Regarding the safety approvals it was mentioned by the SD that it is very expensive to be acquired and sometimes they take a lot of time but they are of great importance for their products especially when they are selling their products abroad.

3.2.2. FORMALITY OF MARKETING EFFORTS

No written guidelines exist in the firm for the marketing efforts to be followed for an innovation. However the SD explained that it is a standard procedure of their company to develop along with the product brochures and leaflets which are sent to the potential customers through direct mail. Again whenever they receive an enquiry by a prospective customer they invite him in the firm for a discussion with the technical director who can answer any technical question.

In addition for products in their existing range they always offer free a SMPS to the customer in order to use it in his operations.

3.2.3. INFORMATION MEDIA USED AND PROBLEMS

Thirteen different information media were presented to the SD in order to find which and to what extent each of them has been used by the firm in order to communicate the innovation among the potential adoptors. A scale from 1 to 7 was used to assess the extent of use for each medium, where 1: not at all and 7:to a great extent.

Table 3.5 illustrates the extent of use of each medium as it was marked by the SD.

Table 3.5 : Information media used

	INFORMATION MEDIA USED	USE
1	Brochures and Leaflets	7
2	Trade shows	4
3	Trade journals	4
4	Technical journals	6
5	Scientific journals	1
6	Personal contacts in professional associations	1
7	Participation in conferences	2
8	Contacts with Universities	4
9	Contacts with governmental institutions	5
10	Informal contacts with customers	5
11	Formal contacts of other firms' managers	2
12	Sales force contacts of potential customers	1
13	Direct mail	6

Scale 1 to 7 were 1:not at all, 7:to a great extent

As it can be seen from this table the firm does not have any industrial door to door salespersons. On the question why not, the SD replied that at the present time due to the small size of their firm they cannot afford such persons because personal visits to each firm are very expensive. In addition their product range is still very small and therefore the few products that they have can be explained to their customers by phone. However she mentioned the intention of the firm to employ such a person in the near future since the product range of the company is increasing.

Regarding the other information media the SD explained that the most effective has been proved the advertisements in trade and technical journals which are mostly international such as IPM, International Equipment News or Electronic Product News. In that respect they have received enquiries from many firms abroad as well as from domestic firms. Each of the above journals operate a readers' enquiry service and the SD mentioned that "to our surprise we have taken enquiries from readers who are Greek firms in Athens and instead of calling or visiting us they used the readers' enquiry service of the magazine".

Furthermore, she mentioned that they have not participated to a great extent in trade shows mainly because it is very expensive and the small range of their products does not allow them to have a proper stand in any exhibition.

The main problems they have faced with the use of the above media is the lack of trade and technical journal in Greece, the relative high cost for advertising their products every month on an international journal and for participating in international exhibitions.

3.2.4. INFORMATION MESSAGES USED

Regarding the information messages used by the firm the SD was asked to indicate on a scale from 1 to 7, the extent in which these messages included the elements which are illustrated in the following Table 3.6.

As the SD stated the firms' messages are concentrated on providing information to customers related to industry's trends, technical characteristics of the product and the R&D resources allocated for the development of it. She explained that firms in Greece, especially manufacturers of machinery, are not well aware of the international trends in the area of power supply systems and therefore in order to promote their own SMPS they have to educate them. Regarding the R&D expenses she explained that they are pointed out because it is of vital importance for the customer to understand that this SMPS is not an imitation of an imported one but it is a genuine product which has been created by means of extensive research and developmental efforts. Again the high R&D expenses indicate to customers the time needed for the development of a product and are used as an excuse for any possible delays in delivery dates.

Table 3.6 : Information messages used

	INFORMATION MESSAGES USED	Content
1	Technical characteristics	7
2	Financial opportunities	4
3	Competitive advantages	2
4	Industry trends	7
5	Company's reputation	4
6	R&D allocation	7
7	After sales service	6

Scale 1 to 7 were 1:not at all, 7:to a great extent

Of great interest is the fact that the competitive advantages to be gained by the adoption of this innovation are not communicated by the firm to a great extent. On the question why not, the SD was unable to give an answer and she said that by pointing out the technical characteristics of the product and the international trends in the industry the customers could realize by themselves that they would have a competitive advantage over firms that were using old technology.

3.2.5. SEGMENTATION AND RELATED STRATEGIES

The firm has a clear segmentation strategy and has identified 5 distinct segments in the market. These are the following:

1. Firms using heavy machinery. The SD explained that each machine has its own supply system but sometimes it is either inappropriate for the condition of a specific factory or it needs replacement mainly for safety or other reasons.

2. Users of computers who want a safer and more advanced power supply system or simply to replace the old one due to problems in operation.

These two segments are served from the existing standard range of SMPS provided by the firm and are sold to them through representatives (not exclusive) all over Greece.

3. Manufacturing firms that develop industrial machinery and other industrial products that need to have a power supply system.

4. Computer manufacturers.

These two later segments are the most important for the company since they demand SMPS to fit the specifications of their own products. The SD mentioned that the firm is focusing on the computers manufacturers since the SMPS is a vital part of a computer and increasing sales of computers mean increasing sales of SMPS for the firm too.

Although the selling strategy for the first two segment is undifferentiated to each customer, for the later two segments the firm differentiates its selling strategy according to the importance of the customer and his expected volume of orders. This differentiation is mainly related to the economic terms of the deal, the number and condition on which samples of SMPS are given by the company and the extent to which technical information and other services are provided by the company. Since large computer manufacturers are the main target of the firm, they develop close relationships with them, they provide full technical assistance and information, more free samples to be tested by them and better economic terms according to the volume of their orders.

For small but important manufacturing firms they provide only one free sample of their product and sometimes depending of the relationships with the customer they provide design assistance for the placement of the power supply system within their machines. However they are careful not to provide extensive technical information because as the SD mentioned, in the past they noticed attempts of such firms to copy the power supply system for their own use and exploitation.

5. State owned enterprises such as the Greek electricity company and the Greek telecommunication company. The SD explained that such companies due to their large operations have many needs for a continuous replacement of their power supply systems. An important feature of this segment is that procurements are performed through public bidings and sometimes concern a very large number of units. However since the firm has yet a small production capability and not enough experience with public bidings they avoid, for the present, large firms in this segment and concentrate on small state owned firms with smaller orders. In that respect they undertook a project for the development of battery charge switching regulator for photovoltaic power sources. The whole project was a success and the SD mentioned that in this way they try to build their reputation so as by the time they will achieve a better production capability to attempt competing for large orders from large state owned enterprises. In general they provide technical assistance and service for one year and they warranty the replacement of any defect system. Finally the SD stated that whenever they face a new customer they take into account his needs and conditions to a great extent and they try to adjust accordingly their selling terms.

3.2.6. PERCEPTION OF CUSTOMERS' RISK AND HANDLING METHODS

The SD stated that the firm takes into account to a great extent the perceived risk of the customer when adopting the innovation.

To this end the SD was asked to indicate which of the following techniques and to what extent are used by the firm in order to reduce the customers' perceived risk. Her answers are illustrated in the following table 3.7.

It is obvious from this table that the firm uses to a great extent all these methods. However the SD explained that the most important of them is to visit and consult other customers' previous experience with the firm. She stated that "this is the best advertisement for our company and the best insurance for any potential customer". In addition she mentioned that the acceptance of penalty contracts for clause provisions is used mainly in the public sector and for procurements of state owned public enterprises. She stated that this method is not very popular in the private sector.

Furthermore the SD stated that the firm has achieved to acquire international safety approvals for its products and in addition it makes known to the customers that the components used for the development of the SMPS have international safety approvals too.

Table 3.7 : Risk handling methods

	RISK HANDLING METHODS	USE
1	Visit operations	7
2	Visit other customers	7
3	Accept penalty contracts	7
4	Provide technical information	7
5	After sales service	7
6	Trial	7

Scale 1 to 7 were 1:not at all, 7:to a great extent

3.2.7. AFTER SALES FEED-BACK & ADJUSTMENTS

The after sales monitoring of the SMPS performance is a formal procedure followed by the firm on a regular basis. The SD explained that this takes the form of phone-calls or visits to their customers where the performance of the SMPS and possible problems during its operation are discussed with the customer.

Furthermore after each sales agreement with a customer there is always an informal discussion among the SD, TD and the PD, where the whole selling policy is discussed and the various points raised by the customer are evaluated. In that respect the SD explained that she was able to identify the most important sources of information used by the customers as well as the main reasons why they approach their company. She stated that word-of-mouth communications among customers is the most frequently cited information source and their credibility and friendly relationships with their customers are among the main reasons that make a customer interested to the firm despite any bad relationships with other Greek companies he might have had in the past. In addition the SD stated that these discussions among members of the firm provide useful information of how the next potential customer should be treated in order to become a customer of the firm.

Overall, the SD stated that the after sales feed-back has resulted to a great extent (point 7 on a scale from 1 to 7) to the use of more effective selling policies by the firm.

3.2.8. VISITS PER SALE/PERCENTAGE OF SALES AND MARKETING BUDGET SPENT FOR THAT INNOVATION/PERCENTAGE OF ADOPTERS THAT WERE ALREADY CUSTOMERS OF THE FIRM

Since the firm has no door-to-door industrial salesmen, no visits are being paid by the firm to customers for the selling of its products. However the customer who expresses his interest for the SMPS is invited to visit the firm and to discuss any issues with the firm's technicians.

The SD explained that in the case where a customer wants a SMPS to be used in the product he is trying to develop, many contacts between him and the firm take place. In that respect technicians from the firm visit his operations as many times as it is needed to understand the customers' specifications since these will outline the dimensions and functional characteristics of the SMPS.

The SD mentioned that 90% of their budget each years goes to research and development and only 10% is allocated for the marketing of their products. However she added that the firm will increase the resources spent for marketing as soon as their product range will become larger than it is now.

Finally regarding the firm's customers it was stated by the SD that they all were new to the firm. However she added that already customers of the firm who attempt the development of a new product for which a new SMPS is needed they do call back for further collaboration with the firm.

3.2.9. MAJOR REASONS FOR ADOPTION OR REJECTION AS PERCEIVED BY THE PRODUCER

According to the SD the firm has identified the following reasons for which its products are adopted in the Greek market.

1. Technical reasons which relate to the performance of the power supply system in comparison with those with older technology.

2. The fact that the firm is willing to modify the design specifications of the product in order to fit the specifications required by the manufacturer who is going to attach that SMPS on his machine or computer.

3. The fact that the product is produced in Greece attributes to it a large Greek added value. Therefore when the product is attached to another product (machine or computer) it increases its Greek added value too. As the SD stated this is very important for firms that

participate in public bidings in Greece since Greek added value is one of the most important buying criteria when products are bought through public procurements.

4. The fact that the firm is situated near to the users of the power supply systems. In that respect the firm can have close communication with its customers and thus good relationships are developed which provide a feeling of assurance to the customers that whatever problem they will face and whenever they will face it, the firm's technicians will be near to solve it as soon as possible.

The SD mentioned the following reasons for rejection:

a) Price. She explained that their SMPS are cheaper than the competitive SMPS produced in Europe or in USA. However compared to those produced in TAIWAN they are slightly more expensive. She added that in specific markets such as in computers manufacturers the power supply system corresponds to the 25% of the total cost of the computer. Therefore for large computer manufacturers even small differences in the price of the SMPS are very important. She also mentioned that although TAIWAN's SMPS are cheaper their quality is inferior to that of their products and to those produced in Europe and USA.

b) The fact that the SMPS is produced in Greece which is not famous for high technology products makes many domestic and foreign customers very sceptical about its quality. This is also enhanced by the fact that there exist only few large companies world-wide which produce supply systems by using the same technology as this Greek company. In addition, she mentioned that the bad relationships in the past of their potential customers with other Greek companies made them reluctant to adopt their products and to collaborate again with a Greek company.

c) The product itself. The SD mentioned that power supply systems due to their small volume and relative easily understood operations are regarded by some manufacturing companies as unimportant within the development process of their own machines. Thus they either produce their own supply systems by using obsolete technology or they buy a cheap one with inferior quality.

APPENDIX B

THE INNOVATIONS

<u>THE CNC BENDING MACHINE</u>

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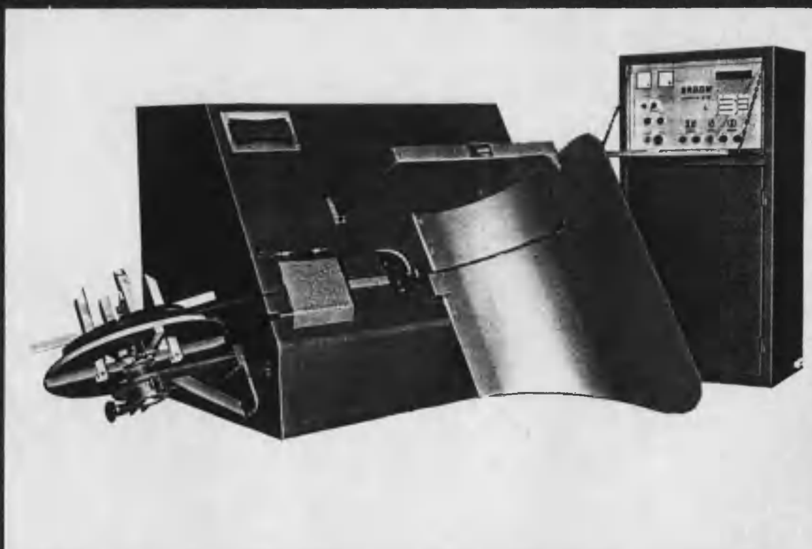
ERGON

Models:

KREV 1 KREV 2 KREV R

CNC PROGRAMMABLE BENDING MACHINES

FOR THE EFFICIENT PRODUCTION OF FRAMES
FOR INNERSPRING UNITS FROM ROUND OR FLAT WIRE



OUR MACHINES PRODUCE FRAMES FROM COIL FULLY AUTOMATIC.
THE UNWINDING, PULLING, STRAIGHTENING, MEASURING, AND BENDING
OCCUR ALL IN ONE STEP.

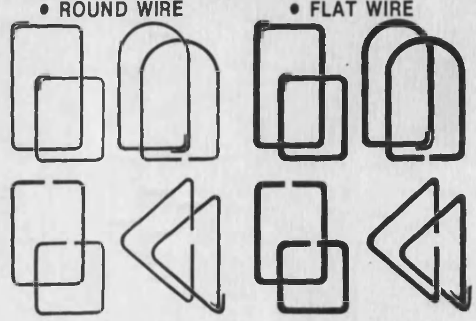
SPECIFICATIONS - PRODUCTION INFORMATION

	KREV 1 FOR FRAMES FROM FLAT STEEL-SINGLE FEED	**KREV 2** FOR FRAMES FROM FLAT STEEL-DOUBLE FEED	**KREV R** FOR FRAMES FROM ROUND STEEL-SINGLE FEED
— Flat wire size max.	12×3 mm	12×3 mm	
— Flat wire size min.	4×1,2 mm	4×1,2 mm	
— Flat wire strength	up to 160 Kg/mm'	up to 160 Kg/mm'	
— Round wire size max.			6 mm
— Round wire size min.			2 mm
— Round wire strength			up to 160 Kg/mm'
— Max. feed speed	80 m/min.	160 m/min.	50 m/min.
— Max. bending speed	900°/sec.	900°/sec.	560°/sec.
— Length cutting accur.	± 0,2 mm	± 0,2 mm	± 0,2 mm
— Angle bending	± 0,5 mm	± 0,5 mm	± 0,5 mm
— Max. side length	2500 mm	2500 mm	2500 mm
— Min. side length	120 mm	120 mm	150 mm
— Installed power	5 KW	7 KW	7 KW
— Electronic controls	24 V direct cur.	24 V direct cur.	24 V direct cur.
— Program input time	in ca. 7 sec.	in ca. 7 sec.	in ca. 7 sec.
— Program input time with code number	in ca. 3 sec.	in ca. 3 sec.	in ca. 3 sec.
— Max. output of frames of medium size	1 every 8 sec.	1 every 4 sec.	1 every 12 sec.
— Dimensions-cm.	ca. 300×110×140 (h)	ca. 350×110×140 (h)	ca. 350×110×140 (h)
— Weight	ca. 650 Kg.	750 Kg.	ca. 850 Kg.

ELECTRONIC CONTROL PANEL WITH KEYBOARD FOR PROGRAMMING AND SWITCH FOR MANUAL OPERATION

- Modern electronic controls with microcomputer.
- The programming is done in dialogue with the computer.
- The computer has the capacity to produce wire shapes with up to 100 different sides and bending angles.
- Frequently needed wire forms can be programmed and directly called-up by code number.
- The straightening takes place through 6 parallel straightening rollers, which are fastened onto the body of the straightener and roll spirally around the wire. With this method, absolutely exact wire is produced.
- We guarantee a 20 times higher life expectancy of the straightening rollers than the normal casts used.
- The oil dynamic unit is made from Bosch-Herion components and is equipped with an air cooler.

• ROUND WIRE • FLAT WIRE



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P. A. ANAGNOS

THE PACKAGING MACHINE

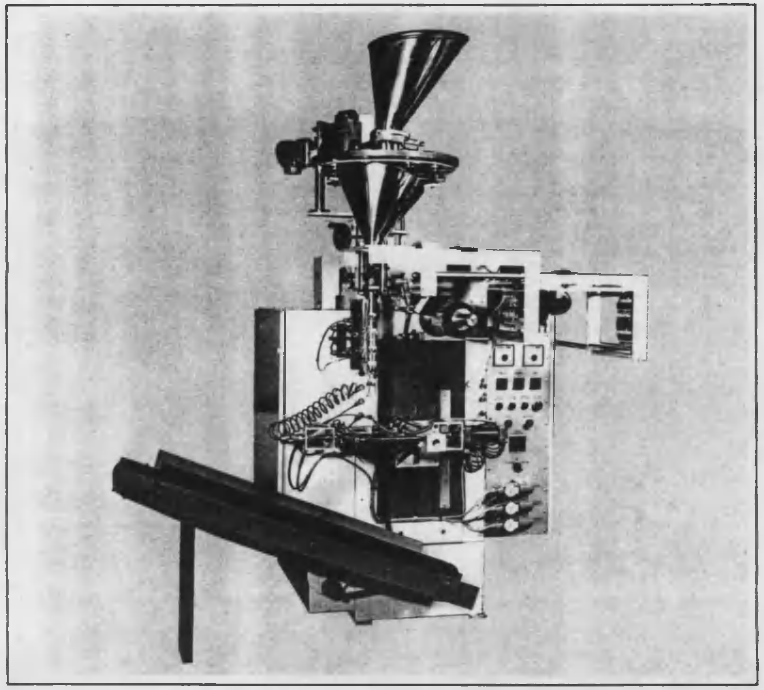
397

PACKAGING MACHINES

EUROPEAN COMMUNITY'S MADE

PAP

POLYPACK



The POLYPACK packing machines, are high technology machines with great productivity and unlimited endurance. They use for package, cellophane, polyethylene, polypropylene, paper sealed by heat, aluminium foil and all the materials sealed by heat.

GENERAL FEATURES

a. Simple operation b. Easy maintainance c. Minimum working space d. Without vibrations
e. Unlimited time of operation f. Very wide field of applications for all categories of products.

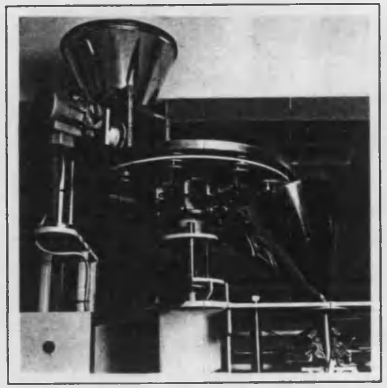
1. In powder, such as chemicals, drugs, medicine - herb, spices, detergents, salts, baby foods, mashed potatoes etc.
2. In grains, such as, legumes, herb - seeds, pop - corn, screws, small accessories.
3. More general, products such as candies, vegetables, pastries etc.

PRODUCTIVITY

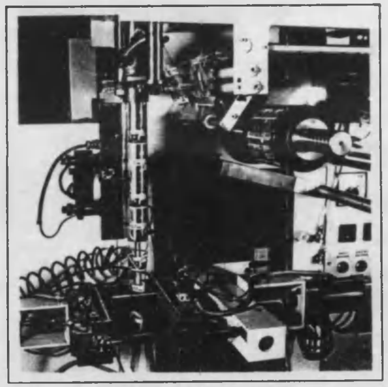
a. From 33 - 45 pieces per minute, depends on the kind of product.
b. Product weight from 10 grams to 1000 grams. More than 1000 grams, requires special order.

TECHNICAL DATA

a. Automatic control of the bag length. Has the ability to control: length 20 - 330 mm, width 57 - 200 mm.
b. Electronic panel to control the machine operation.
c. Automatic lubrication of all the frictioned points.
d. Photocell to control the printed packaging material
e. Printer to print the production and ending date and the price of product.
f. Automatic regulation and control while the machine runs.
g. Dimensions: height 250 cm, width 120 cm, length 110 cm, weight 650 Kgr.
h. Required voltage 220 V or 380 V, resistances 42 V X 1 HP Power 2,5 KW.



Volumetric Disc



Pneumatic system for sealing and cutting of the bag.

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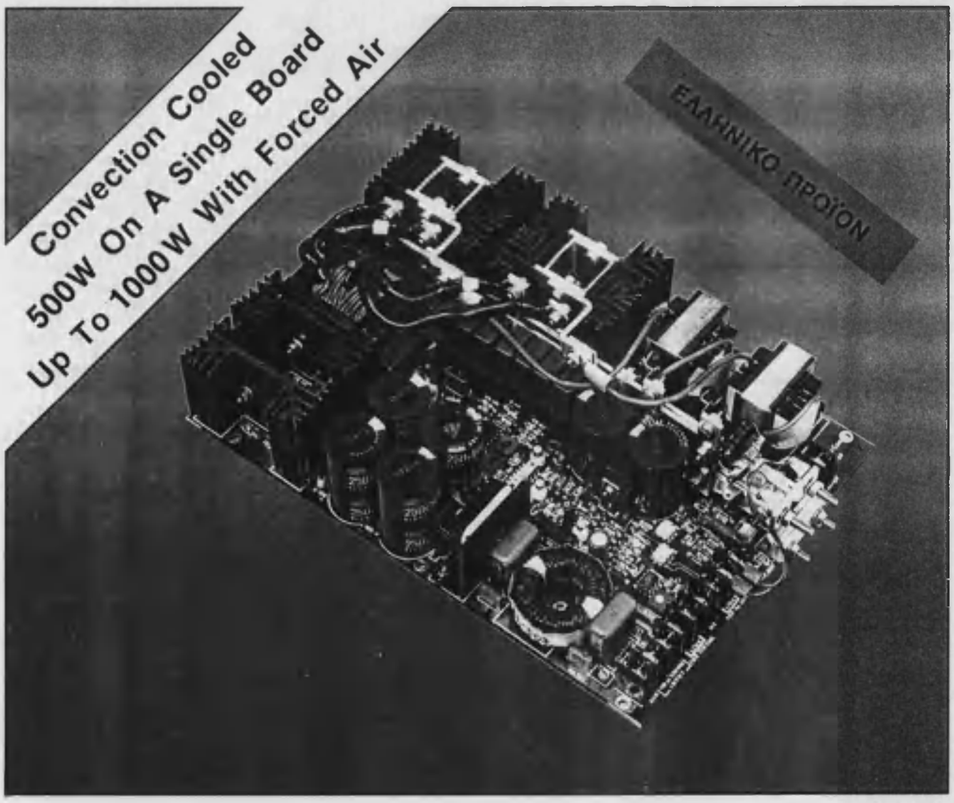
THE POWER SUPPLY SYSTEM

400

HyperCon's HCS-50 series

SWITCHING POWER SUPPLY



☐ 110/220VAC input ☐ Very low profile ☐ Wide output voltage range	☐ High efficiency ☐ Remote turn-on, turn-off ☐ Remote Sensing-Programming	☐ Build in EMI Filter ☐ Fully protected ☐ Latest switching technology

HyperCon Ltd

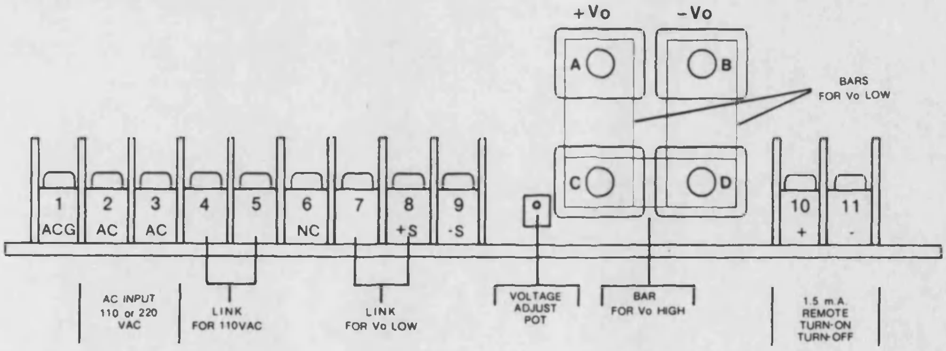
High Technology in Power Conversion

401

HYPERCON'S HCS-50 SERIES

HyperCon's HCS-50 series has been designed for applications requiring a highly reliable, efficient, compact power supply. The ability of choosing the output voltage range, Low or High, is a unique feature for this single output power supply.

CONNECTION DIAGRAM



e.g. The **HCS-50-1224** unit can deliver either 12.5V ± 20%-45A output, or 25V± 20% - 22.5A output. Ideal case for DC on line UPS applications using 12 or 24 volts batteries.

For 12.5V ± 20% output (Vo Low) use the existing BARS and connect **A** with **C** and **B** with **D**.

For 25V ± 20% output (Vo High) use the existing BARS and connect **C** with **D**.

OUTPUT RATINGS

MODEL	SELECTED OUTPUT	VOLTAGE RANGE VOLTS	CURRENT IN AMPS	WATTS OUT NOMINAL
HCS-50-0510	LOW HIGH	5 ± 20% Adj or 10 ± 20% Adj	100 50	500
HCS-50-1224	LOW HIGH	12.5 ± 20% Adj or 25 ± 20% Adj	45 22.5	560
HCS-50-2856	LOW HIGH	28 ± 20% Adj or 56 ± 20% Adj	22.5 11.25	630
HCS-50-64128	LOW HIGH	60 ± 20% Adj or 120 ± 20% Adj	11.5 5.75	690

By forsing air through the package, output power may be increased up to 1000 WATTS.

APPENDIX C

QUESTIONNAIRES

QUESTIONNAIRE IDENTICAL FOR PRODUCERS

AND

ADOPTERS & NON-ADOPTERS OF THE INNOVATIONS

ISSUES

A. THE INDUSTRY

B. MACHINERY AND EQUIPMENT

C. PRODUCTS

D. ORGANIZATIONAL/MANAGERIAL

E. PEOPLE

PART ONE
THE INDUSTRY

Q.1 Using the scale below please indicate how frequently new products are introduced in your industry.

Almost never						Very often
1	2	3	4	5	6	7

Q.2 What percentage of the products introduced the last 5 years in your industry are regarded as:

- Technological innovations .....%
- Imitations .....%

100 %

Q.3 How frequently do the new products introduced in your industry differ from those already existing, on the following issues?

	Almost never						Very often
• Raw materials used	1	2	3	4	5	6	7
• Machinery & Equipment used for their production	1	2	3	4	5	6	7
• Their production methods	1	2	3	4	5	6	7
• Their components	1	2	3	4	5	6	7
• Their uses	1	2	3	4	5	6	7
• Other, please explain:......	1	2	3	4	5	6	7

Q.4 What is the rate of new firms entry into your industry?

Very slow						Very fast
1	2	3	4	5	6	7

Q.5 What are the major reasons that according to you explain the above mentioned rate of new firms entry?

....
....
....

Q.6 By using the following scale, please indicate the rate of technological change internationally, regarding the Raw materials, Machinery & Equipment and Production methods used for the productions of your firms' products.

	Very Slow						Very Fast
• Raw materials	1	2	3	4	5	6	7
• Machinery & Equipment	1	2	3	4	5	6	7
• Production methods	1	2	3	4	5	6	7

Q.7 Please circle the appropriate number in each of the following scales that relate to the intensity of different types of competition in your industry.

	Virtually No Competition						Intense Competition
a) Price competition.	1	2	3	4	5	6	7
b) Competition in product characteristics (quality, variety).	1	2	3	4	5	6	7
c) Competition in promotion/ Service and Distribution/ Delivery.	1	2	3	4	5	6	7
d) Other. please specify:...	1	2	3	4	5	6	7

Q.8 In terms of impact upon the profitability of your company, how important is each of the following types of competition? Please use the following scale to rate the importance of each type of competition.

	Of No Importance						Of great Importance
a) Price competition.	1	2	3	4	5	6	7
b) Competition in product characteristics (quality, variety).	1	2	3	4	5	6	7
c) Competition in promotion/ Service and Distribution/ Delivery.	1	2	3	4	5	6	7
d) Other. please specify:...	1	2	3	4	5	6	7

Q.9 For collecting information relevant to their needs, companies cooperate/ communicate with different information. Does your company:

• **A.** Cooperate/communicate with scientific and research institutions for the collection of information? (please tick)

YES ☐ NO ☐

a1. On what issues are these information?

....

....

a2. How do you communicate with the above institution?

....

....

a3. How frequently do you communicate with them? (please tick)

very rarely						very frequently
1	2	3	4	5	6	7

a4. How difficult it is to communicate with the above institutions?

very easy						very difficult
1	2	3	4	5	6	7

a5. Please circle the degree of importance you allocate to the information you receive from the above institutions.

Not important at all						Very important
1	2	3	4	5	6	7

▪ **B.** Cooperate/communicate with similar firm for the collection of information? (please tick)

YES ☐ NO ☐

b1. On what issues are these information?

....

....

b2. How do you communicate with the above firms?

....

....

b3. How frequently do you communicate with them? (please tick)

<u>very rarely</u>						<u>very frequently</u>
1	2	3	4	5	6	7

b4. How difficult it is to communicate with the above firms?

<u>very easy</u>						<u>very difficult</u>
1	2	3	4	5	6	7

b5. Please circle the degree of importance you allocate to the information you receive from the above firms.

<u>Not important at all</u>						<u>Very important</u>
1	2	3	4	5	6	7

▪ **C.** Cooperate/communicate with your customers (existed and potential) for the collection of information? (please tick)

YES ☐ NO ☐

c1. On what issues are these information?

....

....

c2. How do you communicate with your customers?

....

....

c3. How frequently do you communicate with them? (please tick)

<u>very rarely</u>						<u>very frequently</u>
1	2	3	4	5	6	7

c4. How difficult it is to communicate with your customers?

<u>very easy</u>						<u>very difficult</u>
1	2	3	4	5	6	7

c5. Please circle the degree of importance you allocate to the information you receive from your customers.

<u>Not important at all</u>						<u>Very important</u>
1	2	3	4	5	6	7

<u>Q.10</u> By using the following scale, please indicate the level of technical specifications demanded by the market on your main products.

<u>Very low</u>						<u>Very high</u>
1	2	3	4	5	6	7

Q.11 Please indicate the degree of your markets' receptivity on high technology products, as they incorporate high perceived risk due to lack of previous use.

Not receptive at all						Very receptive
1	2	3	4	5	6	7

Q.12 Please indicate the governmental attitude regarding the production/ adoption of technological innovations by firms in your industrial sector.

very negative						very positive
1	2	3	4	5	6	7

Q.13 According to you, which governmental policies contribute or not to the production/adoption of technological innovation by firms in your industrial sector.

....

....

PART TWO
THE FIRM
MACHINERY AND EQUIPMENT

Q.1 Approximatelly what is the percentage of your firm's capacity utilized during the last 5 years?............%

Q.2 In comparison with other firms in the industry the above capacity utilization rate was:

Very much above						Very much below
1	2	3	4	5	6	7

Q.3 Please indicate which of the following production types corresponds to your firms' production type.

	YES	NO
1.Production of simple or technically complex units to customers' specifications (custom-tailor made)	___	___
2.Production in small batches	___	___
3.Mass production as on an assembly line (automobiles)	___	___
4.Large batch production of components for subsequent assembly	___	___
5.Continuous flow	___	___
6.If no one, please describe briefly your production type....	___	___

Q.4 Please indicate the relevant cost of the following production factors for your firm.

	Very low						Very high
▪ Raw materials	1	2	3	4	5	6	7
▪ Labour	1	2	3	4	5	6	7
▪ Machinery & Equipment	1	2	3	4	5	6	7
▪ Energy	1	2	3	4	5	6	7
▪ Information	1	2	3	4	5	6	7
▪ other, please specify......	1	2	3	4	5	6	7

Q.5 Please state, approximately the average age of the main machinery you use for the production of your main products.........YEARS

Q.6 Approximatelly what percentage of the raw material, machinery & equipment and production methods used for the production of your main products are:

	RAW MATERIALS	MACHINERY & EQUIPMENT	PRODUCTION METHODS
• Technologically advanced	_____%	_____%	_____%
• Are getting obsolete in a slow rate	_____%	_____%	_____%
• Are getting obsolete in a fast rate	_____%	_____%	_____%
• Are already obsolete	_____%	_____%	_____%
	100 %	100 %	100 %

Q.7 Approximately what percentage of your factory's works can be characterized as:

1.Manual work	_____%
2.Mechanical with a great deal of operator's participation	_____%
3.Mechanical, automatic with a low operator's participation	_____%
4.Mechanical, automatic, programmable with a minimum operator's participation	_____%
	100 %

Q.8 Please indicate which of the following technologies you have in your firm as well as the year of purchase for each one.

	YES	NO	YEAR
1.Batch data processing.	---	---	----
2.On-line systems.	---	---	----
3.Real-time systems.	---	---	----
4.Numerical control (NC) machines.	---	---	----
5.Computer numerical control machines (CNC).	---	---	----
6.CAD/CAM, FMS, ROBOTS etc.	---	---	----
7.Production's control systems (CAPP, MRP II etc).	---	---	----
8.Electronic technology on products.	---	---	----
9.Management information systems.	---	---	----
10.Decision support systems.	---	---	----
11.Data banks.	---	---	----

Q.9 What percentage of your firm's investments during the last 5 years were investments in new technologies? ....%

Q.10 To what extent the buildings of your factory(ies) are appropriate for the introduction of large scale new technologies.

Not at all						To a great extent
1	2	3	4	5	6	7

Q.11 To what extent the use of the new technologogies you have bought during the last years have resulted positively on the following sectors:

	Not at all						To a great extent
1.Better management of the firm	1	2	3	4	5	6	7
2.Better utilization of the workforce	1	2	3	4	5	6	7
3.Product quality improvements	1	2	3	4	5	6	7
4.Better utilization of raw materials	1	2	3	4	5	6	7
5.Improvement of the firm's organizational structure	1	2	3	4	5	6	7
6.Better utilization of the rest technological equipment of the firm	1	2	3	4	5	6	7
7.Has increased the flexibility of the firm towards the markets variations on issues like product specifications, quality, quantity etc.	1	2	3	4	5	6	7
8.Price decreases	1	2	3	4	5	6	7
9.Other, please specify	1	2	3	4	5	6	7

PART THREE
THE PRODUCTS

Q.1 Approximately what percentage of your sales come from products:

a.Launched within the last 2 years ____%
b.Launched between 2-5 years ago ____%
c.Launched more than 5 years ago ____%
========
100%

Q.2 How frequently does your firm receive proposals for new products development from people outside the firm?

Almost never						Very often
1	2	3	4	5	6	7

Q.3 How frequently does your firms receive proposals for new products development from people within the firm?

Almost never						Very often
1	2	3	4	5	6	7

Q.4 What percentage of your products belong to each of the following stages of the product life cycle?

INTRODUCTION ______%
GROWTH ______%
MATURITY ______%
DECLINE ______%
============
100%

Q.5 What percentage of your investments during the last 5 years were directed to products on the following stages:

PLC STAGES	NEW RAW MATERIALS	NEW COMPONENTS	NEW MACHINERY & EQUIPMENT	NEW PRODUCTION METHODS
INTRODUCTION	______%	______%	______%	______%
GROWTH	______%	______%	______%	______%
MATURITY	______%	______%	______%	______%
DECLINE	______%	______%	______%	______%
	100%	100%	100%	100%

Q.6 Approximately what percentage of total sales volume is accounted by your five largest customers? _____%

Q.7 How dependent would you say that your company is on your 10 largest customers.

Not dependent at all						Very Dependent
1	2	3	4	5	6	7

Q.8 What percentage of your products generates 80% of your sales turnover?
______%

Q.9 What is the percentage of your sales turnover that qoes to each of the following classes of markets?

Wholesalers...............................____%
Retailers.................................____%
Inustrial manufacturing firms.............____%
Other non-manufacturing firms
(transport, construction).................____%
State organization and institutions........____%
Public (end customers)....................____%

Q.10 To what extent the demands of your main customers for new products and for the technical characteristics of the existing products have led your company to develop new producs and to adopt new production technologies?

	Not at all						To a great extent
New products	1	2	3	4	5	6	7
New production technol.	1	2	3	4	5	6	7

Q.11 To what extent the technological base of your firm can adequately fill the future technological demands of your present and anticipated customers?

Not at all						To a great extent
1	2	3	4	5	6	7

Q.12 What percentage of your products are launched and promoted in the market by your own sales department? _____%

PART FOUR
ORGANIZATIONAL / MANAGERIAL

Q.1 Does your company have an R&D department?

YES ☐ NO ☐

If NO, go to **Q.5**

Q.2 If YES, how many persons are employed in this department? ______

Q.3 What is the percentage of your sales turnover accounted by the R&D budget? ______%

Q.4 Please indicate on which issues the R&D efforts of your firm are oriented.

1. ____
2. ____
3. ____
4. ____

Q.5 Does your company cooperate with other R&D laboratories, organizations or research agencies for the development of new products or for other technical issues.

YES ☐ NO ☐

If NO, go to **Q.7**

If YES, how useful have been proved these cooperations?

Not at all useful						To a great extent
1	2	3	4	5	6	7

Q.6 Approximately the last 5 years what percentage of your total sales turnover was accounted for R&D? ____%

Q.7 Does your company have a Marketing department?

YES ☐ NO ☐

If NO, go to **Q.8**
If YES,
How many persons are employed in this department?_____

Q.8 Does your company have any formal system for the collection of information regarding the marketing of the products (collection, processing)

YES ☐ NO ☐

If NO, go to **Q.9**
If YES,
How many persons are employed in this department?_____

Q.9 Does your company cooperate with marketing research institutions or agencies for collecting information relevant to the market and the products?

YES ☐ NO ☐

If YES, on which issues?

____

____

How frequently does your company cooperate with the above agencies?

Rarely					Very often	
1	2	3	4	5	6	7

Q.10 How do you rate each of the following business functions in terms of its contribution to your company overall success.

	Of little or no importance						extremely important
•.Production	1	2	3	4	5	6	7
•.Finance	1	2	3	4	5	6	7
•.Purchasing	1	2	3	4	5	6	7
•.R&D	1	2	3	4	5	6	7
•.Sales	1	2	3	4	5	6	7
•.Marketing	1	2	3	4	5	6	7
•.Personell	1	2	3	4	5	6	7

Q.11 Does your company have a formally prepared corporate plan?

YES ☐ NO ☐

If NO, please state why?..

....

If YES,

a.How many years does this plan cover? ___

b.How frequently is it revised? ___

c.Which of the following are included in this plan?

	YES	NO
1.Definition of the company's product markets	___	___
2.Long term investments	___	___
3.Future sales volume	___	___
4.Return on investments	___	___
5.Cash flow/liquidity of the firm	___	___
6.Forecast of market price and market share	___	___
7.R&D projects and expenses	___	___
8.New product development prospects	___	___
9.Forecasts of the technological change	___	___
10.Recruitment levels.	___	___
11.Investments in new technologies	___	___

Q.12 To what extent do the following issues hold for your company?

- The company owns the supply of the main raw materials used

Not at all — To a great extent

1 2 3 4 5 6 7

- The company owns or manufactures the supply of parts, tools or components required in operating its plants

Not at all — To a great extent

1 2 3 4 5 6 7

- The company produces goods derived or manufactured from its own main products

Not at all — To a great extent

1 2 3 4 5 6 7

- The company is responsible for wholesaling its products (ie. owns wholesale outlets)

Not at all — To a great extent

1 2 3 4 5 6 7

- The company is responsible for retailing its products (ie. owns retail outlets)

Not at all — To a great extent

1 2 3 4 5 6 7

Q.13 How extensive is the participation of staff other than top management in decision on the adoption of new policies?

Very extensive — Minimal

1 2 3 4 5

Q.14 How extensive is the participation of employees other than top management in the decision to hire new executives?

Very extensive — Minimal

1 2 3 4 5

Q.15 How extensive is the participation of employees other than top management in the desicion on the promotion of any of the professional staff?

Very extensive — Minimal

1 2 3 4 5

Q.16 Please circle the number which best indicate the situation in your own company for each one of the following questions and statements.

	Definitely false	More false than true	More true than false	Definitely true
▪ There can be little action taken here until a superior approves a decision	☐	☐	☐	☐
▪ A person who wanted to make his own desicion would be quickly discouraged	☐	☐	☐	☐
▪ Even small matters have to be referred to someone higher up for a final solution.	☐	☐	☐	☐
▪ Any desicion an employee makes has to have his superior approval.	☐	☐	☐	☐
▪ In our organization employees are encouraged to feel they are their own superiors in most matters.	☐	☐	☐	☐
▪ How things are done here is left up to persons doing the job.	☐	☐	☐	☐
▪ Most people here make their own rules on the job.	☐	☐	☐	☐
▪ Whatever situation arises there are procedures to follow in dealin with it	☐	☐	☐	☐
▪ Every one has a specific job to do.	☐	☐	☐	☐
▪ This organization keeps written records of everyone's performance.	☐	☐	☐	☐
▪ Everyone has to follow strict operating procedures at all time.	☐	☐	☐	☐
▪ Whenever there is a problem one is supposed to go to the same person for an answer.	☐	☐	☐	☐
▪ Going through the proper channels is constantly stressed in our company.	☐	☐	☐	☐
▪ The employees here are constantly being checked for rule violations.	☐	☐	☐	☐
▪ There is a friendly relationship between management and employees.	☐	☐	☐	☐
▪ Employees create problems to management (conflicts, strikes e.t.c)	☐	☐	☐	☐

PART FIVE
PEOPLE

Q.1 What percentage of your employees have a degree in the following areas:

1.Technical and engineering ....%
2.Management ....%

Q.2 Does your company have a formal recruitment policy?

YES ☐ NO ☐

Please elaborate a)for the managers

b)for the workforce

Q.3 To what extent does your company encourage each of the following activities.

	Not at all						To a great extent
a)Attendance of local and/or national professional meetings and conferences	1	2	3	4	5	6	7
b)Overseas professional meetings and conferences	1	2	3	4	5	6	7
c)Membership of professional societies and associations	1	2	3	4	5	6	7

Q.4 Approximately what percentage of your company's managerial staff have been abroad at least one time? _____%

Q.5 Does your company have a library?

YES ☐ NO ☐

Q.6 How favorable would you say it is the employees' attitude towards the introduction of new technologies?

	Not at all favorable						Very favorable
For the managers	1	2	3	4	5	6	7
For the workforce	1	2	3	4	5	6	7

QUESTIONNAIRE FOR PRODUCERS OF INNOVATIONS

ISSUES

A. THE DEVELOPMENT OF THE INNOVATION

B. THE MARKETING OF THE INNOVATION

THE DEVELOPMENT OF THE INNOVATION

Q.1 Generally speaking, please refer to the motives(incentives) that have led your company to develop the specific innovation.

Q.2 Generally speaking, please refer to the factors that have allowed your company to develop the specific innovation.

Q.3 Time when the idea was first introduced:.......
Q.4 Time of the final production:..................
Q.5 Time of the first market adoption:............

Q.6 The innovation idea came from within the firm or from another firm? (please elaborate)

Q.7 If within the firm, who has initiated the idea?

If outside: a)Which firm has proposed the idea?

b)Who became first aware of this idea in the firm

Q.8 Who has played an important role in each of the following stages of the innovation development process? (names and organizational position)

A.Conceptualization of the final product characteristics
name:
B.Technical evaluation of the innovation
name:
C.Financial evaluation
name:
D.Commercial evaluation
name:
E.Final decision to develop the product
name:
F.Evaluation of alternative launching policies
name:
G.Final desicion regarding the launching policy
name:

Q.9 How important was your role in the following stages of the innovation development process?

	not at all important						very important
• Initiation of the idea	1	2	3	4	5	6	7
• Conceptualization of the product characteristics	1	2	3	4	5	6	7
• Technical evaluation	1	2	3	4	5	6	7
• Financial evaluation	1	2	3	4	5	6	7
• Commercial evaluation	1	2	3	4	5	6	7
• Final desicion to develop the product	1	2	3	4	5	6	7
• Evaluation of alternative launching policies	1	2	3	4	5	6	7
• Final desicion regarding the launching policy	1	2	3	4	5	6	7

Q.10 From what you remember please describe the main problems you have faced during the development of the product as well as the ways you have employed to overcome these problems.

Q.11 From the following information sources, please choose the first 7 in terms of their importance in helping you to perform your tasks during the various stages of the product development process (Show card).

	INITIATION OF THE IDEA	CONCEPTUALIZATION OF THE PRODUCT'S CHARACTERISTICS	TECHNICAL EVALUATION	FINANCIAL EVALUATION	COMMERCIAL EVALUATION	EVALUATION OF ALTERNATIVE LAUNCHING POLICIES
Prior studies of mine						
Prior experience						
Formal contact in firm						
Personal informal contacts with members of other firms						
Personal formal contacts with members of other firms						
Contacts with potential users						
Attendance of conferences						
Membership of professional organizations						
Contacts with university or research laboratories						
Contacts with governmental institutions						
Marketing research						
Trade journals						
Technical journals						
Scientific Journals						
Direct mail						
other						

Q.12 Have you faced any problems in using these information sources?
Please elaborate

Q.13 During the conceptualization of the product characteristics how important was the role of the final users of the product in defining them?

not at all important						very important
1	2	3	4	5	6	7

(please elaborate)

Q.14 Have you faced any differences between the users' perceptions of the product characteristics and those of your company?

How did you have overcome those differences?

Q.15 Have you introduced any new materials, new machinery and production methods in order to satisfy the customers' demands for the product's characteristics?

not at all						To a great extent
1	2	3	4	5	6	7

Q.16 To what extent the following factors have played an important role in deciding the final characteristics of the innovation?

	not at all						to a great extent
1.Users' perceptions	1	2	3	4	5	6	7
2.Firm's technical capabilities	1	2	3	4	5	6	7
3.Firm's machinery & equipment	1	2	3	4	5	6	7
4.Market research	1	2	3	4	5	6	7
5.Financial evaluation	1	2	3	4	5	6	7

Q.17 Could you please describe which characteristics this product has that make it attractive to the final users.(please rank them 1st, 2nd... according to their importance)

Q.18 To what extent does the product meet the following criteria?

	not at all						to a great extent
1.Low initial cost	1	2	3	4	5	6	7
2.Low running cost	1	2	3	4	5	6	7
3.Low pay-off period	1	2	3	4	5	6	7
4.High flexibility in use	1	2	3	4	5	6	7
5.High reliability in operation	1	2	3	4	5	6	7
6.Ease of understanding	1	2	3	4	5	6	7
7.Labour savings	1	2	3	4	5	6	7
8.Product quality improvements	1	2	3	4	5	6	7
9.Space savings	1	2	3	4	5	6	7
10.It is compatible with the existing manufacturing operations of the users	1	2	3	4	5	6	7
11.It is compatible with the existing technical experience and expertise	1	2	3	4	5	6	7
12.Lowers the unit cost of end product	1	2	3	4	5	6	7
13.Permits trial in a small scale	1	2	3	4	5	6	7
14.Provide better equipment utilization	1	2	3	4	5	6	7
15.Introduces savings in production time	1	2	3	4	5	6	7
16.Increases variety of end products	1	2	3	4	5	6	7
17.It encompasses advanced technology	1	2	3	4	5	6	7

Q.21 When you evaluated the innovation what kind of analysis have you used and why? (PP,ROI,PI etc) How typical is this behaviour?

Q.22 When evaluating the innovation did you use any qualitative data?
YES....... NO.......

IF YES, exactly what data and why? (how typical is this behaviour)

Q.23 Have you financed the development of the innovation alone or have you used any outside help?(i.e. governmental help, from the supplier etc.)
IF NO, why not?

IF YES, please specify the sources and elaborate.

IF YES, to what extent this outside financial help was important for the final development of the innovation?

Of no importance						Of great importance
1	2	3	4	5	6	7

Q.24 Please describe the commercial evaluation process for this innovation. (probe for marketing and market research)

Q.25 To what extent the following factors have led you to the final desicion to produce the innovation?

	not at all						to a great extent
1.R.O.I	1	2	3	4	5	6	7
2.Payback period	1	2	3	4	5	6	7
3.Profit per unit	1	2	3	4	5	6	7
4.Compatibility with our production capabilities	1	2	3	4	5	6	7
5.Compatibility with our technical knowledge	1	2	3	4	5	6	7
6.Competitive activities	1	2	3	4	5	6	7
7.Good market responce	1	2	3	4	5	6	7
8.Large number of potential adopters	1	2	3	4	5	6	7
9.Low failure risk	1	2	3	4	5	6	7
10.Vital for the firm's image	1	2	3	4	5	6	7
11.It was a technical challenge to you personally	1	2	3	4	5	6	7
12.General trends in the industry	1	2	3	4	5	6	7
13.Ease of patentability	1	2	3	4	5	6	7
14.Other, please explain...........	1	2	3	4	5	6	7

Q.26 When did you first think about the way your firm is going to launch the product?

Q.27 What alternative launching methods have you thought?

Q.28 Which one have you chosen and why?

THE MARKETING OF THE INNOVATION

Q.1 Does your company have any written procedures which have to be followed during the launching process of this and any new product?

Q.2 To what extent did your company rely on the following information vehicles in order to make the product known to the end users.

	not at all						to a great extent
1.Brochures and Leaflets	1	2	3	4	5	6	7
2.Trade shows and Exhibitions	1	2	3	4	5	6	7
3.Trade journals	1	2	3	4	5	6	7
4.Sales force	1	2	3	4	5	6	7
5.Formal contacts with managers in other firms	1	2	3	4	5	6	7
6.Informal contacts with managers in other firms	1	2	3	4	5	6	7
7.Trade Associations	1	2	3	4	5	6	7
8.Contacts with governmental organ.	1	2	3	4	5	6	7
9.Participation in conferences	1	2	3	4	5	6	7
10.Direct mail	1	2	3	4	5	6	7
11.Other, explain..........	1	2	3	4	5	6	7

Probe for problems in using these information vehicles as well as for the frequency of use

Q.3 To what extent you have stressed the following characteristics when contacting the final potential users of the innovation, and why?

	not at all						to a great extent
1.Technical characteristics	1	2	3	4	5	6	7
2.Financial opportunities	1	2	3	4	5	6	7
3.Competitive advantages over other products	1	2	3	4	5	6	7
4.Industry trends	1	2	3	4	5	6	7
5.Company's reputation	1	2	3	4	5	6	7
6.R&D allocation for this product	1	2	3	4	5	6	7
7.After sales service	1	2	3	4	5	6	7
8.Other, explain	1	2	3	4	5	6	7

Q.4 Did you take any account for the segmentation of the market for this innovation? (focus market)

If yes, probe for the procedures
If no, why not?

Q.5 To what extent the specific situation of each potential adopter has been taken into account and different selling policies have been formulated?

not at all						To a great extent
1	2	3	4	5	6	7

(please elaborate)

Q.6 What is the promotional mix for this innovation?

Financial help:

Technical help:

After sales services:

Q.7 To what extent the risk perceptions of the buyer both for him and the company have been taken into account during the formulation of the marketing mix of this innovation.

not at all						To a great extent
1	2	3	4	5	6	7

Q.8 To what extent your firm follows the actions mentioned below for the risk elimination of the potential adopter of the innovation?

	not at all						to a great extent
1.Invite the buyer to visit our operations	1	2	3	4	5	6	7
2.Invite the buyer to visit our customers	1	2	3	4	5	6	7
3.Accept contract of penalty clause provisions	1	2	3	4	5	6	7
4.In case of an already customer we stress our past cooperation	1	2	3	4	5	6	7
5.We offer extensive technical informations	1	2	3	4	5	6	7
6.We offer extensive after sales services	1	2	3	4	5	6	7
7.Other, explain.................	1	2	3	4	5	6	7

Q.9 To what extent the performance of this innovation has been scrutinized after the selling and this haw led to more effective use of the promotional activities?

not at all						To a great extent
1	2	3	4	5	6	7

Is the after sales research a formal task for your company?
Yes____ No____

Q.10 On average how many contacts did the salespersons of your company have with a potential buyer before the final desicion of the adoption of the innovation. ________

Q.11 What percentage of your total marketing and sales budget has been accounted for this particular innovation. _______%

Q.12 Which firms have already adopted the innovation? Please refer to their names in a chronologicaly order of adoption

Q.13 What percentage of the already adopters of the innovation were already customers of your firm. _______%

Q.14 Which firms have been approached by you but they have denied the adoption of the innovation?

Q.15 Please refer to the main reasons according to which firms have adopted or rejected the adoption of this innovation.

QUESTIONNAIRE FOR THE ADOPTERS OF THE INNOVATIONS

Q.1 Generally speaking, please refer to the motives (incentives) that have led your company to adopt the specific innovation.

Q.2 Generally speaking, please refer to the factors that have allowed your company to adopt the specific innovation. (enabling conditions)

Q.3 Year you have adopted the innovation
Year.......

Q.4 Year that you first became aware of the innovation.
Year.......

Q.5 Does your company have any written procedures that have to be followed during the adoption process of this and any other innovation?

YES...... NO.....
(please elaborate)

Q.6 Please describe in general the procedures you have followed from the awareness of this innovation to the final adoption of it.

Q.7 Including you, who have played a major role in the adoption process of this innovation (from the initiation of the idea to the final decision to adopt the innovation) (probe for activities of each one)

Q.8 How important was your role in the following stages of the innovation adoption process?

	not at all important						very important
Initiation of the idea	1	2	3	4	5	6	7
Information gathering							
Technical information	1	2	3	4	5	6	7
Financial information	1	2	3	4	5	6	7
Technical evaluation	1	2	3	4	5	6	7
Financial evaluation	1	2	3	4	5	6	7
Final decision to adopt the innovation	1	2	3	4	5	6	7

Q.9 Would you say that there is a person in your company whose opinion was vital for the final adoption of this innovation?

YES...... NO.....
(please elaborate)

Q.10 How well would you say was the cooperation between the various departments of your firm during the adoption process of the innovation?

Please explain:

Q.11 How useful would you say that the following sources of information were in providing you with information about this innovation during the various stages of the adoption process? (please rank 1st, 2nd ...7th, the seven most useful of them)

	INITI-ATION OF THE IDEA	COLLECT TECHNICAL INFO.	COLLECT FINANCIAL INFO.	EVALU-ATION	FINAL DECIS. TO REJECT IT
Prior studies of mine					
Prior experience of mine					
Personal formal contacts with company's other staff					
Personal non-formal contacts with managers of other firms					
Personal formal contacts with managers of other firms					
Contacts with other already users of the innovation					
Attendance of seminars					
Membership of professional organizations					
Contacts with university or research laboratories					
Contacts with governmental institutions					
Technical journals					
Other scientific journals					
Brochures & Leaflets					
Particiapation in trade shows and exhibitions					
Supplier's sales force					
Direct mail					
other					

Q.12 Have you faced any problems in using these information sources? YES...... NO..... (please elaborate)

Q.13 Did you approach anyone in another company in the industry for advice or opinion when seeking information?

YES...... NO..... (please elaborate)

Q.14 Could you please describe which characteristics of it have accounted more during the evaluation of this innovation, for the final positive decision to adopt it? (please rank them 1st, 2nd,... according to their importance)

Q.15 To what extent does the innovation meet the following criteria?

	not at all						to a great extent
1.Low initial cost	1	2	3	4	5	6	7
2.Low running cost	1	2	3	4	5	6	7
3.Low pay-off period	1	2	3	4	5	6	7
4.High flexibility in use	1	2	3	4	5	6	7
5.High reliability in operation	1	2	3	4	5	6	7
6.Ease of understanding	1	2	3	4	5	6	7
7.Labour savings	1	2	3	4	5	6	7
8.Product quality improvements	1	2	3	4	5	6	7
9.Space savings	1	2	3	4	5	6	7
10.Increases variety of end products	1	2	3	4	5	6	7
11.It is compatible with the existing manufacturing operations of the users	1	2	3	4	5	6	7
12.It is compatible with the existing technical experience and expertise	1	2	3	4	5	6	7
13.Lowers the unit cost of end product	1	2	3	4	5	6	7
14.Permits trial in a small scale	1	2	3	4	5	6	7
15.Provide better equipment utilization	1	2	3	4	5	6	7
16.Introduces savings in production time	1	2	3	4	5	6	7
17.It encompasses advanced technology	1	2	3	4	5	6	7

Q.16 When you evaluated the innovation what kind of analysis have you used and why? (PP,ROI,PI etc) How typical is this behaviour?

Q.17 When evaluating the innovation did you use any qualitative data?

YES....... NO.......

IF YES, exactly what data and why? (how typical is this behaviour)

Q.18 Have you used any external financial help for the procurement of the innovation? (i.e. governmental help,

YES..... NO.......

IF NO, why not?

IF YES,

A) to what extent this outside financial help was important for the final adoption of the innovation?

Of no importance						Of great importance
1	2	3	4	5	6	7

B) please specify the sources and elaborate.
(what sources you would like to have but you couldn't use)

Q.19 When the decision to go ahead with the adoption of this innovation was made, did you draw up a formal list of suppliers?

YES...... NO.....

IF YES, a)How many suppliers were on the short list?

b)Who was selected and why?

Q.20 To what extent did your company become involved with the supplier in the design and development of the innovation?

	not at all						to a great extent
• In suggesting the original idea	1	2	3	4	5	6	7
• In evaluating and modifying the development as the design was developed	1	2	3	4	5	6	7
• In evaluating and modifying any prototype	1	2	3	4	5	6	7

Q.21 Have you bought any other machinery or equipment from this particular supplier in the past.

YES...... NO.....

Q.22 What kind of contacts did you have with this particular supplier during the adoption process of this innovation?

Probe for:

-Personal contacts with managers of the supplier firm

-Personal contacts with the sale force of the supplier

-Phone calls etc.

Q.23 To what extent did the messages from the supplier have given you sufficient information about the following aspects:

	not at all						to a great extent
1.Technical characteristics of the innovation	1	2	3	4	5	6	7
2.Various ways to finance the adoption of the innovation	1	2	3	4	5	6	7
3.Competitive advantages to be gained from the use of the innovation	1	2	3	4	5	6	7
4.Insights to our industry trends	1	2	3	4	5	6	7
5.The reputation and the credibility of the supplier	1	2	3	4	5	6	7
6.R&D efforts allocated to this innovation	1	2	3	4	5	6	7
7.Amount and quality of after sales services	1	2	3	4	5	6	7

Q.24 Please name which of the above information have influenced more your decision to adopt the innovation?

Q.25 If you would like to have more information please specify the issues on which you would like to have these information.

Q.26 Generally speaking, how important were the following factors when you assessed the suitability of the supplier?

	Of no importance						Of great importance
1.General business reputation	1	2	3	4	5	6	7
2.Ease of communication with him	1	2	3	4	5	6	7
3.Technical progressiveness	1	2	3	4	5	6	7
4.Financial position	1	2	3	4	5	6	7
5.Quality of management	1	2	3	4	5	6	7
6.Past experience with the company	1	2	3	4	5	6	7
7.After sales service	1	2	3	4	5	6	7
8.Geographical proximity	1	2	3	4	5	6	7
9.Domestic than overseas based	1	2	3	4	5	6	7
10.Other...........................	1	2	3	4	5	6	7

Q.27 When you took the final decision to adopt the innovation how confident you were that:

	Not at all confident						Very confident
1.It would meet the claims of the supplier on performance	1	2	3	4	5	6	7
2.It would be compatible with the existing manufacturing operations	1	2	3	4	5	6	7
3.It would be reliable	1	2	3	4	5	6	7
4.It would be easy to operate	1	2	3	4	5	6	7
5.It would be easy to maintain	1	2	3	4	5	6	7
6.It would give you the expected	1	2	3	4	5	6	7
advantages over your competitors.	1	2	3	4	5	6	7

Q.28 To what extent the following actions make you to feel more confident for the decision to favor the particular supplier for this innovation?

	not at all						to a great extent
1.Visiting the operations of the potential supplier to observe its viability firsthand	1	2	3	4	5	6	7
2.Visiting and questioning customers of the potential supplier	1	2	3	4	5	6	7
3.Obtaining contract of penalty clause provisions from the potential supplier	1	2	3	4	5	6	7
4.In choosing a supplier, you favor firms that your company has done business with in the past	1	2	3	4	5	6	7
5.Limiting the search of a potential supplier to only well-known firms	1	2	3	4	5	6	7
6.Obtaining the opinion of a majority of your co-workers that the chosen vendor is satisfactory	1	2	3	4	5	6	7
7.Trial of the product for a small period of time within the firm	1	2	3	4	5	6	7
8.Other...........................	1	2	3	4	5	6	7

Q.29 After the installation of this innovation in your company, have you faced any problems during the use of it?

YES____ NO_____

If YES, what kind of problems?

What was the participation of the producer during the effort to solve those problems.

Of what specific actions have you thought in order to avoid such problems in the future with similar machines?

Q.30 Generally speaking, how content you are with the use of this innovation?

Not at all Content						Very Content
1	2	3	4	5	6	7

Q.31 With how much reservation would you buy new machines in the future from this specific supplier?

With No reservation						With great reservation
1	2	3	4	5	6	7

Q.32 Certainly many suppliers have approached you in order to sell their products. You have bought some of those products and rejected others. Could you please refer to the main reasons that you commonly reject the adoption of a product that has been proposed to you?

THE NON-ADOPTERS QUESTIONNAIRE

Q.1 Generally speaking, which were the reasons that you have rejected the adoption of this innovation. Please elaborate.

Q.2 Year that you first became aware of the innovation. Year.......

Q.3 Does your company have any written procedures that have to be followed during the adoption/rejection process of this and any other innovation?

YES...... NO.....
(please elaborate)

Q.4 Please describe in general the procedures you have followed from the awareness of this innovation to the final rejection of it.

Q.5 Including you, who have played a major role in the adoption process of this innovation (from the initiation of the idea to the final decision to reject the innovation) (probe for activities of each one)

Q.6 How important was your role in the following stages of the innovation adoption process?

	not at all important						very important
Initiation of the idea	1	2	3	4	5	6	7
Information gathering							
Technical information	1	2	3	4	5	6	7
Financial information	1	2	3	4	5	6	7
Technical evaluation	1	2	3	4	5	6	7
Financial evaluation	1	2	3	4	5	6	7
Final desicion to reject the innovation	1	2	3	4	5	6	7

Q.7 Would you say that there is a person in your company whose opinion was vital for the final rejection of this innovation?
YES...... NO.....
(please elaborate)

Q.8 How well would you say was the cooperation between the various departments of your firm during the adoption process of the innovation?

Please explain:...

Q.9 How useful would you say that the following sources of information were in providing you with information about this innovation during the various stages of the adoption process? (please rank 1st, 2nd ...7th, the seven most useful of them)

	INITIATION OF THE IDEA	COLLECT TECHNICAL INFO.	COLLECT FINANCIAL INFO.	EVALUATION	FINAL DECIS. TO REJECT IT
Prior studies of mine					
Prior experience of mine					
Personal formal contacts with company's other staff					
Personal non-formal contacts with managers of other firms					
Personal formal contacts with managers of other firms					
Contacts with other already users of the innovation					
Attendance of seminars					
Membership of professional organizations					
Contacts with university or research laboratories					
Contacts with governmental institutions					
Technical journals					
Other scientific journals					
Brochures & Leaflets					
Particiapation in trade shows and exhibitions					
Supplier's sales force					
Direct mail					
other					

Q.10 Have you faced any problems in using these information sources?
YES...... NO..... (please elaborate)

Q.11 Did you approach anyone in another company in the industry for advice or opinion when seeking information?

YES...... NO.....

(please elaborate)

Q.12 Could you please describe which characteristics of it have accounted more during the evaluation of this innovation, for the final negative desicion to adopt it? (please rank them 1st, 2nd,... according to their importance)

Q.13 To what extent does the innovation meet the following criteria?

	not at all						to a great extent
1.Low initial cost	1	2	3	4	5	6	7
2.Low running cost	1	2	3	4	5	6	7
3.Low pay-off period	1	2	3	4	5	6	7
4.High flexibility in use	1	2	3	4	5	6	7
5.High reliability in operation	1	2	3	4	5	6	7
6.Ease of understanding	1	2	3	4	5	6	7
7.Labour savings	1	2	3	4	5	6	7
8.Product quality improvements	1	2	3	4	5	6	7
9.Space savings	1	2	3	4	5	6	7
10.It is compatible with our existing manufacturing operations	1	2	3	4	5	6	7
11.It is compatible with our existing technical experience and expertise	1	2	3	4	5	6	7
12.Lowers the unit cost of end product	1	2	3	4	5	6	7
13.Permits trial in a small scale	1	2	3	4	5	6	7
14.Provide better equipment utilization	1	2	3	4	5	6	7
15.Introduces savings in production time	1	2	3	4	5	6	7
16.Increases variety of end products	1	2	3	4	5	6	7
17.It encompasses advanced technology	1	2	3	4	5	6	7

Q.14 When evaluating the innovation did you use any qualitative data?

YES..... NO.......

IF YES, exactly what data and why? (How typical is this behaviour)

Q.15 When you evaluated the innovation what kind of analysis have you used and why? (PP,ROI,PI etc) How typical is this behaviour?

Q.16 Have you attempted to use any external financial help for the procurement of the innovation? (i.e. governmental help, from the supplier etc.)

YES..... NO.......

IF NO, why not?

IF YES,
A) to what extent this outside financial help was important for the adoption of the innovation?

Of no importance						Of great importance
1	2	3	4	5	6	7

B) please specify the sources and elaborate.
(what sources you would like to have but you couldn't use)

Q.17 What kind of contacts did you have with this particular supplier during the adoption process of this innovation?

Probe for:

-Personal contacts with managers of the supplier firm

-Personal contacts with the sale force of the supplier

-Phone calls etc.

Q.18 To what extent did the messages from the supplier have given you clear information about the following aspects:

	not at all						to a great extent
1.Technical characterisics of the innovation	1	2	3	4	5	6	7
2.Various ways to finance the adoption of the innovation	1	2	3	4	5	6	7
3.Competitive advantages to be gained by the use of the innovation	1	2	3	4	5	6	7
4.Insights to our industry trends	1	2	3	4	5	6	7
5.The reputation and the credibility of the supplier	1	2	3	4	5	6	7
6.R&D efforts allocated to this innovation	1	2	3	4	5	6	7
7.Amount and quality of after sales services	1	2	3	4	5	6	7
8.Other, please specify................	1	2	3	4	5	6	7

Q.19 Please name which of the above information have influenced more your decision to adopt the innovation?

Q.20 If you would like to have more information please specify the issues on which you would like to have these information.

Q.21 Generally speaking, how important are the following factors when you assessed the suitability of the supplier?

	Of no importance						Of great importance
1.General business reputation	1	2	3	4	5	6	7
2.Ease of communication with him	1	2	3	4	5	6	7
3.Technical progregriseveness	1	2	3	4	5	6	7
4.Financial position	1	2	3	4	5	6	7
5.Quality of management	1	2	3	4	5	6	7
6.Past experience with the company	1	2	3	4	5	6	7
7.After sales service	1	2	3	4	5	6	7
8.Geografical proximity	1	2	3	4	5	6	7
9.Domestic than overseas based	1	2	3	4	5	6	7
10.Other...........................	1	2	3	4	5	6	7

Q.22 When you took the final decision to reject the innovation how confident you were that:

	Not at all confident						Very confident
1.It would meet the claims of the supplier on performance	1	2	3	4	5	6	7
2.It would be compatible with the existing manufacturing operations	1	2	3	4	5	6	7
3.It would be reliable	1	2	3	4	5	6	7
4.It would be easy to operate	1	2	3	4	5	6	7
5.It would be easy to maintain	1	2	3	4	5	6	7
6.It would give you the expected	1	2	3	4	5	6	7
advantages over your competitors.	1	2	3	4	5	6	7

Q.23 To what extent the following actions make you to feel more confident for the decision to favor a particular supplier for this innovation?

	not at all						to a great extent
1.Visiting the operations of the potential supplier to observe its viability firsthand	1	2	3	4	5	6	7
2.Visiting and questioning customers of the potential supplier	1	2	3	4	5	6	7
3.Obtaining contract of penalty clause provisions from the potential supplier	1	2	3	4	5	6	7
4.In choosing a supplier, you favor firms that your company has done business with in the past	1	2	3	4	5	6	7
5.Limiting the search of a potential supplier to only well-known firms	1	2	3	4	5	6	7
6.Obtaining the opinion of a majority of your co-workers that the chosen vendor is satisfactory	1	2	3	4	5	6	7
7.Trial of the product for a small period of time within the firm	1	2	3	4	5	6	7
8.Other.............................	1	2	3	4	5	6	7

Q.24 Certainly many suppliers have approached you in order to sell their products. You have bought some of those products and rejected others. Could you please refer to the main reasons that you commonly reject the adoption of a product that has been proposed to you?

APPENDIX D

SOME ISSUES WHICH ALSO HAVE BEEN INVESTIGATED

D.1. INTRODUCTION

In addition to the variables which were examined in the main body of this thesis, a number of other issues and their influence on the adoption response of firms also were investigated. These issues are reported in the present appendix which encounters the influence on the adoption response of firms of the following factors:

a. the cost of production factors;
b. the inappropriateness of the factory buildings of the firm;
c. the existence of a marketing department within a firm and its collaboration with marketing research agencies;
d. the importance of different business functions of the firm;
e. the educational background of the firm's staff; and
f. the cosmopolitanism of the firm's managerial staff;

D.2. THE COST OF PRODUCTION FACTORS

Regarding the cost of production factors, each factor's cost was ranked by respondents on a scale from 1 to 7, where 1: very small and 7: very high. As expected, comparisons between adoptors and non-adoptors in table 9.5.2. indicate that, in contrast with non-adoptors, adoptors face a higher cost of machinery & equipment and consequently a higher consumption of energy, and a lower cost of labour which can be regarded as an immediate result of their investment in machinery and equipment.

Table 1.: Cost of production factors and adoption response

	Relative cost of production facators	Adopters	Non-Adopters			
		Mean Rank		Cases	U	Sig.*
1	Cost of raw materials	14.44	15.79	17,12	92.5	0.660 (X)
2	Cost of labour	11.50	19.96	17,12	42.5	0.005 (*)
3	Cost of machinery & equipment	17.85	10.96	17,12	53.5	0.023 (*)
4	Cost of energy	17.18	11.92	17,12	65.0	0.081 (*)
5	Cost of information	10.82	7.43	17,12	24.0	0.178 (X)
6						
7						
8						

* Two-tailed test (a=10%)

D.3. INAPPROPRIATENESS OF FACTORY BUILDINGS

In chapter 4, it was shown that inadequate buildings or site is a characteristic of technically unprogressive firms (Carter & Williams 1958). Moreover, it was found that this can delay the adoption and diffusion of innovations (Ray 1989) since, additional investments are needed by the adopting unit, which eventually increase the cost of the innovation per se (Webster 1969). On the basis of that it was decided to investigate the buildings' (factories) condition of the adopting and non-adopting firms. To this end, respondents were asked on a scale from 1 to 7, to indicate the extent to which their factory buildings need to be changed in order to facilitate the adoption of major technological innovations, (where 1: not at all and 7: to a great extent).

As it can be seen from the following table 2., the buildings of the non-adopting firms are more inappropriate than those of the adopting firms, since they need changes to a greater extent than the latter in order to facilitate the adoption of major innovations.

To assess the effect of this difference between adoptors and non-adoptors upon their adoption response, the reader must be reminded of the following issues: a) the CNC BENDING MACHINE as an innovation, was replacing a large sized table in the firms' operations, which occupied more space than this innovation, b) the dimensions of the PACKAGING MACHINE are the standard dimensions of a vertically loaded packaging machine, and c) the POWER SUPPLY SYSTEM is very small in size and thus, it hardly occupies any space in the factory. In light of the above insights one would have expected the inappropriateness of the buildings of non-adoptors (in terms of space) to have a positive effect in the adoption of the CNC BENDING MACHINE and the POWER SUPPLY SYSTEM and no effect in the adoption of the PACKAGING MACHINE. However, as it was found from the personal interviews with non-adoptors the need to change their factories' buildings or site was dictated by other reasons such as lack of storage space (mainly for non-adoptors of innovation No.1 & 2). Moreover, it was found that the need to change their factories' buildings was a pressing one and although quite costly it was ranked highly in their investment priorities. As such, and due to their limited economic resources, it was functioning as an economic constraint for any other investment and consequently for the adoption of the innovations in question.

Table 2.: Inappropriateness of factory buildings
and adoption response

VARIABLE:Inappropriateness of factory buildings

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	11.94	19.33	17,12	50.0	0.009 (*V)

COMMENT:The buildings of non-adoptors need more changes than those of the adoptors in order to facilitate the adoption of major innovations.

D.4. MARKETING ACTIVITIES OF THE FIRM

Similarly to research and development activities, marketing activities of firms (especially market research) have been found indicating firms with a high receptivity to technological innovations (Baker 1975a, Abu-Ismail 1976). In order to examine whether such a link exist between marketing activities and adoption response for the firms in the present sample, the following questions and procedures were used:-

1. Respondents were asked to indicate whether there is a marketing department in their firm; the Chi-square test was used to test any differences between adoptors and non-adoptors. 2. Respondents in firms which had a marketing department were further asked to indicate the number of persons employed full-time in that. 3. Finally respondents were asked to indicate whether their firms collaborate with market research companies, and if yes, on which issues. Moreover the frequency of such collaborations was investigated by means of a scale from 1 to 7, where 1: very rarely and 7: very often. Successively, the relevant responses were analysed by the use of the chi-square test and the Mann-Whitney U test respectively.

Table 3. illustrates the results from the above analysis and indicates that only a small number of firms either have a marketing department or collaborate with market research firms. As such no significant differences were found between adoptors and non-adoptors. This result is consistent with the lack of marketing orientation and/or comprehensive marketing approaches of small firms which has been acclaimed by many researchers in the past (Lamont 1972, Ford & Rowley 1979, Kinsey 1987, Peterson 1989).

Table 3.: Marketing activities and adoption response

VARIABLE: Existence of a marketing department.

	YES	NO	TOTAL
Adopters	5 (29.4%)	12 (70.6%)	17 (100%)
Non-Adopters	2 (16.7%)	10 (83.3%)	12 (100%)

VARIABLE: Collaboration with market research firms.

	YES	NO	TOTAL
Adopters	6 (35.3%)	11 (64.7%)	17 (100%)
Non-Adopters	3 (25%)	9 (75%)	12 (100%)

VARIABLE: Frequency of collaborations for market research.

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	4.75	5.50	6,3	7.5	0.342 (X)

COMMENT: There is no significant difference between adoptors and non-adoptors regarding their collaborations with other firms for market research purposes.

D.5. THE IMPORTANCE OF DIFFERENT BUSINESS FUNCTIONS

As it was noticed above, both research & development activities and marketing activities were not only performed by a small number of firms, but were also unable to distinguish adoptors from non-adoptors. However, R&D and marketing are not but two of the many functions of contemporary firms. To this end, as it was noticed in chapter 4, Baker (1975a) found that receptivity of firms to technological innovations is positively connected with the importance attached to the main business functions. Taking this into account, it was decided to investigate the link between adoption response and importance attached to different business functions by firms in this study. In doing so, a difficulty was encountered in distinguishing clearly these functions within the firms, mainly due to their small size. Only production, purchasing and sales were clearly identified as different functional areas, and in some cases (especially for firms in the electronics sector), the R&D and the marketing department were clear too. However, when testing the research instrument (questionnaire) it was found that considerable time and effort were devoted by firms for the finance and the personnel administration and therefore, they were also included in the present investigation.

In order to test the above hypothesized link, respondents were asked to rate each functional area of their firms in terms of its contribution to their company's overall success. To this end, a scale was used from 1 to 7, (where 1: of little or no importance and 7: of great importance). Moreover, the individuals' ratings were aggregated and divided by the number of non-missing cases, thus producing a single indicator of the overall contribution of the functional areas to the firms' success (Cronbach's a:0.7276). The relevant responses, both for its functional area and the aggregated indicator, were then analysed by means of the Mann-Whitney U test, and the results are illustrated in the following table 4. From this table the following conclusions emerge:-

With the exception of the production function, adoptors perceived each of their functional areas as contributing more to their firms' overall success than the non-adoptors did. Moreover, the most significant differences between the two were in relationship to the sales and personnel areas which were rated higher by adoptors than by non-adoptors. However, although not significantly, non-adoptors attributed to their production function a higher contribution to their overall success than the adoptors did. These differences are capable of revealing the different orientation of firms (Abu-Ismail 1976), and as such, their influence upon the behavioural response of the firms in this study can be explained as follows:

The active and effective selling orientation of adopting firms influence their adoption behaviour in two ways: firstly, it brings them face to face with competitive offerings and new customer demands (product features, price, services etc.) which in turn, initiate the adoption of innovation as a mean for fulfilling their customers' demands and for gaining a competitive edge over their competitors, secondly, an effective selling places increasing demands in their production process thus fostering and enabling the adoption of innovations compatible with their needs. Moreover, by paying attention to their personnel they exploit a factor which has been found consistently in past research to stimulate the awareness of innovation and facilitate their adoption. As such, all of the above add credence to the reasons for the adoption of innovations cited previously in section 7.1. by the adoptors. In contrast, non-adopters, being locked in a false production orientation by their managerial choices in the competitive game (see section 7.1.: price competition) and product/ market arena (see sections 7.1, 7.4. i.e. dependance on few old products and customers who are not receptive to technological innovations), lack not only the market incentives to engage in the adoption of innovations but also the necessary resources for reacting to the changing market conditions.

Table 4.: Adoption response and contribution of individual functional areas

	Functional Areas	Adopters	Non-Adopters			
		Mean Rank		Cases	U	Sig.*
1	Production	14.06	16.33	17,12	86.0	0.226 (X)
2	Finance	11.67	10.11	12,9	46.0	0.274 (X)
3	Purchasing	13.65	13.22	17,9	74.0	0.443 (X)
4	Research and development	6.00	4.75	6,4	9.0	0.214 (X)
5	Sales	17.44	11.54	17,12	60.5	0.016(*V)
6	Marketing	4.10	3.75	5,2	4.5	0.439 (X)
7	Personell	13.13	8.17	12,9	28.5	0.029 *V)

VARIABLE: Overall contribution of functional areas

	ADOPTERS	NON-ADOPTERS			
TEST	MEAN RANK		CASES	U	SIGNIFICANCE
M-W	16.74	12.54	17,12	72.5	0.092 (V)

COMMENT: Overall, adoptors perceive their firms' functional areas as contributing more to the success of their firms than the non-adoptors do.

D.6. EDUCATIONAL BACKGROUND AND COSMOPOLITANISM OF THE MANAGERIAL STAFF

An issue which adds to the ability of a firm to generate and assimilate information about new technological innovation, is the educational background and the cosmopolitanism of its managerial staff (Hage 1965, Kimberly & Evanisko 1981, Abu-Ismail 1976, Dewar and Dutton 1986, Carter & Williams 1958). As it was shown in chapter 4, past research has associated the scientific or technical background of managers with their ability to proliferate and assimilate the new technological issues inherent to innovations. However, innovation, apart from technological issues, involve managerial considerations. Therefore, an economic or in management background of a firm's staff has been found equally important, as the technical background, in the adoption of innovation (Cohn 1980, Baker 1975a).

In order to assess the influence of the educational background and cosmopolitanism upon the adoption response of firms in the present study, the following procedures were employed: 1) respondents were asked to cite the percentage of the staff employees that have a) graduated from technical colleges or universities, b) graduated from economic or management schools, and c) travelled abroad even once, 2) the percentage figures provided by respondents were then normalised by the use of the common logarithm (Log10) in order to satisfy the criteria of the t-test for the investigation of any differences between adoptors and non-adoptors. The results of these procedures are illustrated in the following table 5.

Regarding educational background, results show although not significantly, a tendency which indicates that, in comparison with non-adopting firms, adopting firms have a higher proportion of their staff possessing a technical or management degree. Similarly, results indicate significantly that the level of cosmopolitanism of staff in adoptors is higher than that of non-adopting firms.

Table 5.: Educational background/cosmopolitanism of managerial staff and adoption response

VARIABLE: Percentage of staff from technical schools.

			Adopters	Non-Adopters			
F-value	SIG.	Estim..	Mean		Cases	t-test	SIG.
2.84	0.092	Separ.	1.712	1.499	14,9	-1.4	0.097 (V)

COMMENT: There is no significant difference between adoptors and non-adoptors in relationship to their staff graduated from technical schools.

VARIABLE: Percentage of staff from economic or management schools.

			Adopters	Non-Adopters			
F-value	SIG.	Estim..	Mean		Cases	t-test	SIG.
1.26	0.839	Pooled	1.366	1.066	10,6	-1.4	0.091 (V)

COMMENT: There is no significant difference between adoptors and non-adoptors in relationship to their staff graduated from economic or management schools.

VARIABLE: Cosmopolitanism

			Adopters	Non-Adopters			
F-value	SIG.	Estim..	Mean		Cases	t-test	SIG.
1.25	0.768	Pooled	1.907	1.803	13,9	-2.9	0.004 (*V)

COMMENT: Results indicate, significantly, that the percentage of managerial staff travelled abroad is higher in adopter firms than in non-adopters.

APPENDIX E

THE USE OF DISCRIMINANT ANALYSIS

E.1. OBJECTIVE AND VALUE OF DISCRIMINANT ANALYSIS

A tendency in analysing data composed wholly or partly of nominal and ordinal variables has been to ignore their discrete nature and to proceed with continuous variable techniques. In the case of classification or discrimination this approach leads to the use of a linear discriminant function which was first derived by Fisher. The use of this discriminant function and of its' many variations, thereafter, in marketing research studies has been by any standard extensive. Among the many applications of this procedure are studies of innovator profiles, relevant criteria for segmenting markets and consumer brand preference behavior (See for example Uhl et al,.1970, Pessemier et al. 1967, Ostlund 1972, Robertson & Kennedy 1968).

The objective of discriminant function analysis is to classify individuals or objects, by a set of independent variables, into one of two or more mutually exclusive and exhaustive categories or classes (Morrison 1974). The linear discriminant function takes the following form:

$$Zi = bo + b1X1i + b2X2i + ... + bnXni$$

Where:

Xji : the ith object's value of the jth independent variable bj : the discriminant coefficient for the jth variable Zi : the ith object's discriminant score n : the number of individual variables

The mathematical details of discriminant analysis are similar to those of multiple regression. The discriminant coefficients (the b's) are analogous to the regression coefficients. However, instead of explaining variance of the dependent variable as is done in regression, the aim of the discriminant function is to correctly classify as many objects as possible.

According to Crask and Perrault (1977), the use of discriminant function analysis in marketing research has proved most beneficial for three major purposes: 1) developing predictive models to "classify" individuals into groups, 2) "profiling" characteristics of groups which are most dominant in terms of discriminant functions and/or 3) identifying the major underlying dimensions (i.e. discriminant functions which differentiate among groups).

E.2. SPECIFICATIONS REQUIRED AND ASSOCIATED PROBLEMS

According to Klecka (1980) the assumptions which underlie discriminant analysis are:

1. existence of two or more groups.
2. at least two cases per group.
3. any number of discriminating variables, provided that it is less than the total number of cases minus two.

4. discriminating variables are measured at the interval or ratio level.
5. no discriminating variables may be a linear combination of other discriminating variables.
6. the covariance matrices for each group must be (approximately) equal, unless special formulas are used.
7. each group has been drawn from population with multivariate normal distribution on the discriminating variables.

Several authors have shown that discriminant analysis is a rather robust technique which can tolerate some deviation from the above assumption (Lachenburch 1975).

Regarding the multivariate normality assumption, deviations from normality appear more likely to be the rule rather than the exception (Eisenbeis 1977, Dillon 1979). However, violations of the normality assumption may bias the tests of significance, and the estimated classification error rates. These biases arise since we are comparing a statistic computed from a sample to a theoretic probability distribution for that statistic, and also classification is based on the probability of group membership which are calculated from the chi-square distribution that is appropriate only when the discriminating variables have a multivariate normal distribution.

The tactic which most researchers have adopted to deal with violations of multivariate normality is simply to be satisfied that the more standard discriminant procedures yield reasonable approximations and to proceed as if the normality assumption held. The theoretical and statistical work dealing with the normality problems have been of two major types. Some have investigated alternative schemes where specified types of non-normality hold while others have evaluated the robustness and bias introduced in the standard procedure when the normality assumption is violated in known ways. In examining the robustness of the standard techniques when non-normality holds, Gilbert (1969) concluded that there was only a small loss in predictive accuracy using the linear function and that as the number of variables increased the results should be quite stable. Lachenburch, Sneeringer and Revo (1973), investigated the robustness of both linear and quadratic procedures for three specific nonmultivariate normal distributions, the log normal the logit normal and the inverse hyperbolic sine normal. They found that the estimated overall classification error rates were not affected as much as the individual group error rates. The same authors suggested that data should be transformed, if possible, to approximate normality. However the transformation of the variables, most frequently by using the natural and standard log, may change the interrelationships among the variables and may also affect the relative positions of the observations in the group (Eisenbeis 1977).

Regarding the equality of the group dispersion matrices across all groups, relaxation of this assumption affects not only the significance test for the differences in group means but also the appropriate form of the classification rules (Eisenbeis 1977, Dillon 1979).

Finally regarding the collinearity among the independent variables, high degree of collinearity will result to unstable discriminant coefficients and it will be more difficult to interpret the contribution of each independent variable to the overall discriminatory power of the function (Morrison 1969). However some authors argue that multicollinearity is a sample property that is largely an irrelevant concern in discriminant analysis except where the correlations are such (high) that it is no longer possible to invert the dispersion matrices (Eisenbeis 1973,1977).

E.3. ASSESSING THE VALIDITY OF DISCRIMINANT ANALYSIS

According to Morrison (1977), after results from a discriminant analysis are obtained there are three basic questions to ask.

1. Which independent variables are good discriminators?
2. How well do the independent variables discriminate among the two groups?
3. What decision rule should be used for classifying individuals?

The validation of the results of the discriminant analysis although not restricted to small sample research studies becomes a critical issue as the sample size is decreased (Crask and Perrault 1977, Frank et al 1965, Morrison 1969).

E.3.1. Methods for evaluating the importance of the discriminant variables

Regarding the importance of the discriminating variables Eisenbeis et al. (1973) has produced a list of methods which attempt to determine it. These methods rank the discriminating variables on the basis of:

(1) their univariate F-statistic,

(2) their scaled discriminant function coefficients which are weighted by the appropriate diagonal elements of the pooled within groups deviations sums of squares matrix,

(3) stepwise forward methods based on the contribution to the multivariate F-statistic,

(4) stepwise backward methods as in (3),

(5) a conditional deletion method which removed each variable in turn from the m-variable set with replacement and ordered variables according to the resulting reduction in overall discriminatory power as measured by the (m-1) variable F-test.

An other method suggested by Mosteller and Wallace (1963) weights each pairwise and test space coefficient by the difference in the group means divided by the differences in the mean discriminant scores.

From the comparison and the limitations of each of the above methods Eisenbeis (1977) concluded that the conditional deletion method has the greatest appeal since the relative importance of each variable is conditional based on the inclusion of all other variables.

Crask and Perreault in their article in JMR 1977, used a Jackknife method to estimate the stability of the discriminant coefficients. To this end they estimated first the Jackknifed discriminant coefficients and they tested their stability by the traditional standard error. Because the Jackknife coefficients approximate the t distribution (Mosteller & Tukey 1968), each coefficient can be divided by its associated standard error to give a t-value; the degrees of freedom for the t-value are based on the number of partitions of the sample, which have been used for the derivation of the jackknifed coefficients, minus 1.

E.3.2. Methods for evaluating the classification error rates

In order to find how well the independent variables discriminate among the groups one must compare the proportion of the correct classified cases with the proportion of the cases expected to be correctly classified by chance. An analysis of the appropriate chance criteria can be found in Morrison (1969). If we denote as p the true proportion of Type I individuals and a the proportion classified as Type I, then the probability of an individual being classified correctly is:

P(correct)=P(correctclassified type I)*P(classified Type I) +
P(correctclassified Type II)*P(classified Type II)
= p*a + (1-p)*(1-a)

The above formula represents the proportional chance criterion and should be used for validation of the results when the discriminant function can not perform better than that. More formally this proportional chance criterion is:

Cpro=a2 + (1-a)2

But if the objective of the analysis is to maximize the percentage of the correctly classified then the appropriate criterion is the maximum chance criterion which is:

Cmax=max(a,1-a)

According to Morrison the above chance models apply to individuals or cases not used in calculating the discriminant function. If the individuals were used in calculating it then some upward adjustment must be made on Cpro and Cmax since the proportion of observations correctly classified suffers from different sources of biases.

The following discussion presents such bias and various methods employed for the estimation of the classification error rates.

Of vital importance in the validation of the results from a discriminant analysis is the estimation of the classification error rates. Classification errors occur in discriminant analysis for a variety of reasons. Very early in the marketing literature the sources of such errors have been identified. Specifically Frank et al. (1965) identified two major sources of bias in the classification. These are the bias due to sampling errors in estimating the means of the populations. The same authors argue that even in cases where the true discriminatory power of the analysis is zero, errors of sampling or measurement, given identical populations, may produce set of means that differ in some respect or other, and the discriminant analysis will focus on these spurious relations in the maximization of Q i.e. the proportion of sample observations correctly classified. Such spurious relation are more possible to occur when the sample size is decreasing and the relative magnitude of each case in the sample is increasing (Crask & Perrault 1977).

The second source of bias, which in fact is inherent to any research study is the search bias. In this procedure the researcher tries to find out of the total amount of variables he has, the best subset of them that provide the best discriminatory power. But whilst this may hold for the sample he has it might well no hold for the population in question mainly due to the peculiar characteristics exhibited by the sample but not by the population.

Eisenbeis (1977), presents a list of the various procedures that have been used for the estimation of the classification error rates for the case of two groups with equal dispersion. These methods are:

1.The original sample method
2.The Holdout method
3.The population method
4.The D method
5.The D* method
6.The DS method
7.The O method
8.The OS method
9.The _"Lachenbruch" or U method
10.The U method

Lachenbruch & Mickey (1968) and Cohran (1968) have evaluated some or all of those methods and concluded that the U method appear to be the best especially for small samples.